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Journal of the Society of Arts.

FRIDAY, FEBRUARY 8, 1856.

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EXAMINATION OF MEMBERS OF CLASSES IN INSTITUTES.

The Council of the Society of Arts propose to hold, at their House in the Adelphi, an Examination of Candidates from the Classes of Mechanics' Institutions, during the week commencing the 9th June next. The subjects of examination will be, Mathematics, Mechanics, Chemistry, Physiology, Botany, Geography, English History, English Composition, and the Latin, French, and German Languages. The following are the names of the examiners:—The Astronomer Royal; Dr. Bernays; Hon. and Rev. S. Best; Rev. Dr. Booth, F.R.S.; Rev. Professor J. S. Brewer; C. Brooke, Esq., F.R S.; Rev. Professor W. Browne; Dr. Carpenter, F.R.S.; Harry Chester, Esq.; Rev. S. Clark; the Dean of Christ Church, Oxford; Viscount Ebrington, M.P.; Rev. Dr. Elder; J. Glaisher, Esq., F.R.S.; the Dean of Hereford; R. Hunt, Esq., F.R.S.; Dr. Bence Jones, F.R.S.; Professor Moseley, F.R.S.; Rev. Bath Power; F. R. Sandford, Esq.; John Simon, Esq., F.R.S.; Professor Edward Solly, F.R.S.; Rev. F. Temple; Rev. Dr. Vaughan (Harrow); Dr. Watson; Professor John Wilson, F.R.S.E.

Full particulars respecting the examinations will appear in the next number of the *Journal.*

The Council have the pleasure to announce that Robert Stephenson, Esq., M.P., F.R.S., President of the Institution of Civil Engineers, and Vice-President of this Society, has placed at the disposal of the Council the sum of ten guineas, for promoting the proposed Examinations of Members of Classes in Institutes.

The Council are also glad to learn that at a meeting of the Committee of the Lewes Mechanics' Institution, held January 30th, 1856, a report of a meeting of Representatives from various Institutions, held at the Society of Arts, on the 18th of that month, having being received from Mr. Henry Browne—

It was resolved:—

"That the proposed plan for class-examinations for certificates and testimonials is most important, highly beneficial to Mechanics' Institutions, and likely to assist in the self-education of the members; this Committee beg to express their entire approval of the proposition, and hope that it may be effectually carried out."

COMMITTEES OF REFERENCE.

The subjoined list is published in accordance with the following Bye-law:—

36. The Council shall proceed, as soon as convenient after the Annual General Meeting, to form lists of those who may be considered specially eligible to serve with others on such Committees of Reference as may be appointed from time to time. To these Committees the Council may refer for examination, advice and report such discoveries, inventions, improvements, and novelties in Arts, Manufactures, and Commerce, and other matters, as shall from time to time be brought under its notice. The names of the members so selected to serve on the several Committees of Reference shall be published in the *Journal* of the Society, and due notification of the Council's desire to obtain their co-operation and advice shall be given to each member.

Art.

Sir Charles Barry, R.A., F.R.S.	Architecture.
James Bell, M.P.	Architecture.
John Bell	Sculpture.
Henry R. Bradbury	Printing.
R. E. Branston	Wood Engraving.
Vincent Brooks	Lithography.
Decimus Burton, F.R.S.	Architecture.
F. S. Cary	Painting.
A. E. Chalon, R.A.	Painting.
R. D. Chantrell	Architecture.
A. Claudet, F.R.S.	Photography.
Edward Clowes	Printing.
George Clowes	Printing.
John Coe	Printing.
Henry Cole, C.B.	
Dominic Colnaghi	Engraving.
J. G. Crace	Decoration.
Hon. E. C. Curzon	Ancient Art.
P. H. Delamotte	Wood Engraving and Photography.
William Day	Lithography.
C. Wentworth Dilke, B.C.L.	
Roger Fenton	Photography.
A. W. Franks	Ancient Art and Decoration.
P. W. Fry	Photography.
George Gwilt	Architecture.
Edward Hailstone	Ancient Art.
Michael Hanhart	Lithography.
Philip Hardwick, R.A., F.R.S.	Architecture.
B. Waterhouse Hawkins	Modelling.
M. Rohde Hawkins	Architecture.
H. T. Hope	Ancient Art and Decoration.
Owen Jones	Architecture and Decoration.
W. E. Kilburn	Photography.
Rev. W. T. Kingsley, B.D.	Photography.
J. H. Lance	Painting.
G. C. Leighton	Lithography.
John Leighton	
George Mair	Architecture.
Count de Montizon	Photography.
William Mulready, R.A.	Painting.
Matthew Noble	Sculpture.
Rev. J. L. Petit	Architecture.
Richard Redgrave, R.A.	Painting.
David Roberts, R.A.	Painting.
Henry Roberts	Architecture.
Sir W. C. Ross, R.A.	Painting.
William Rowney	Lithography.
Sidney Smirke, A.R.A.	Architecture.
John Thompson	Wood Engraving.
William Tite, M.P., F.R.S.	Architecture.
Henry R. Twining	Painting.
Thomas Uwins, R.A.	Painting.
John Webb	Ancient Art.
Charles Whittingham	Printing.
M. Digby Wyatt	Architecture and Decoration.
Leonard C. Wyon	Medals.

MANUFACTURES.

Edward Akroyd.
John Bettridge, jun.
S. H. Blackwell.
J. M. Blashfield.
Henry Blundell.
T. W. Booker, M.P.
Thomas Broadwood.
John Brocklehurst, M.P.
Charles Brook.
Robert Brown.
John Bull.
Joseph Burch.
William Caldecott.
R. L. Chance.
William Charley.
Chas. Thornton Coathupe.
George Courtauld.
John Crossley.
Joseph Curling.
Abraham Darby.
Thomas De la Rue.
Thomas Dickins.
Henry Doulton.
Robert T. Fauntleroy.
Henry Forbes.
John Foster.
Sebastian Garrard.
T. F. Gibson, F.G.S.
Stephen Green.
Warren S. Hale.
C. F. Hancock.
John Heathcote, M.P.
Charles Hindley, M.P.
M. D. Hollins.
Herbert Mountford Holmes.
George Norgate Hooper.
S. M. Hubert.
G. T. Kemp.
R. W. Kennard.
Alfred Lapworth.
J. R. Lavanchy.
Frederick Levick.
William Liddiard.
Sampson Lloyd.
Samuel Messenger.
Robert Milligan, M.P.
Herbert Minton.
J. A. Nicholay.
Apsley Pellatt, M.P.
James Pilkington, M.P.
Arthur Powell.
Nathaniel Powell.
C. A. Preller.
John Proctor.
James Rock, jun.
Titus Salt.
W. B. Simpson.
John Jobson Smith.
Henry Spicer.
W. R. Spicer.
William Stones.
Henry Thompson.
James Vavasseur.
Samuel Waterhouse.
J. P. Brown Westhead.
John Wilkinson.
Edward Wilson.
Thomas Winkworth.
Henry Woods.

COLONIES AND COMMERCE.

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Francis Bennoch.
William Bird.
Charles Henry Blake.
Edgar A. Bowring.
John Strettell Brickwood.
William Brown, M.P.
R. W. Crawford.
John Dillon.
Sir James Duke, Bart., M.P.
J. G. Frith.
J. P. Gassiott, F.R.S.
J. W. Gilbart, F.R.S.
Peter Graham.
Samuel Gregson, M.P.
Earl Grey.
William Hawes.
Thomson Hankey, M.P.
Thomas F. Henley.
Jonathan Hopkinson.
A. C. Ionides.
Henry Johnson.
Professor Leone Levi.
Matthew Marshall.
George Moffatt, M.P.
John Morley.
Samuel Morley.
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Lord Overstone.
John Patterson.
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J. D. Powles.
William George Prescott, F.G.S.
George Prevost.
Alfred Reade.
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J. Forbes Royle, M.D., F.R.S.
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Hon. R. Temple.
John Ingram Travers.
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Col. Challoner.
John Clutton.
J. Evelyn Denison, M.P.
Francis Fuller.
John Girdwood.
Chandos Wren Hoskyns.
Rev. Anthony Huxtable.
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Charles Lawrence.
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Philip W. S. Miles.
J. C. Morton.
Sir Joseph Paxton, M.P.
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R. W. Kennard.
Herbert Mackworth.
Thomas Sopwith, F.R.S.
John Taylor, jun.
James Tennant.

CHEMISTRY AS APPLIED TO ARTS.

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F. Crace Calvert.
Dugald Campbell.
Warren De la Rue, F.R.S.
Michael Faraday, F.R.S.
Dr. J. H. Gilbert.
T. H. Henry, F.R.S.
Capt. L. L. Boscawen Ibbetson, F.R.S.
J. B. Lawes, F.R.S.
G. Dixon Longstaff, M.D.
Henry Medlock.
Thos. N. R. Morson.
John C. Nesbit.
John H. Pepper.
Dr. Lyon Playfair, C.B., F.R.S.
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J. Bailey Denton.
Lieut.-Col. Eardley-Wilmot, R.A.
J. E. Errington.
William Fairbairn, F.R.S.
Peter Fairbairn.
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Charles Frodsham.
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C. W. Lancaster.
Joseph Locke, M.P., F.R.S.
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Joseph Maudslay.
Thomas Maudslay.
Charles May, F.R.S.
J. R. McClean.
Andrew Murray.
John Murray.
Major H. C. C. Owen, R.E., C.B.
Thomas Page.
John Penn.
James Platt.
W. A. Provis.
J. U. Rastrick, F.R.S.
J. M. Rendel, F.R.S.
Sir John Rennie, F.R.S.
J. Scott Russell, F.R.S.
C. W. Siemens.
James Simpson.
William Simpson.
Robert Stephenson, M.P., F.R.S.
Cornelius Varley.
Charles Vignoles, F.R.S.
James Walker, F.R.S.
Thomas Webster, F.R.S.
William Weallens.
Joseph Whitworth.
Henry Wilkinson.
Edward Woods.

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Marquis of Blandford, M.P.
John Brady, M.D., M.P.
R. Scott Burn.
Edwin Chadwick, C.B.
T. K. Chambers, M.D.
Viscount Ebrington, M.P.
William Farr, M.D., F.R.S.
James Glaisher, F.R.S.
William Hawes.
H. Bence Jones, M.D., F.R.S.
Waller Lewis, M.D.
Prof. Owen, F.R.S.
B. W. Richardson.
John Simon, F.R.S.
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William Ewart, M.P.
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William Johnson Fox, M.P.
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Earl Granville.
Earl of Harrowby.
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Prior Purvis, M.D.
Samuel Redgrave.
Henry Reeve.
John S. Reynolds.
Rev. Arthur Rigg.
Very Rev. the Dean of St. Paul's.
Very Rev. the Dean of Salisbury.
F. R. Sandford.
Lord Stanley, M.P.
Col. W. H. Sykes, F.R.S.
Jelinger C. Symons.
Rev. F. Temple.
E. C. Tufnell.
Rev. Dr. Vaughan (Harrow)
Rev. Richard Whittington.
The Bishop of Winchester.

THE WORKING CLASSES OF EUROPE.*

The condition of the European workman is so intimately connected with the progress and development of the Arts, that the following letter, giving an account of the contents of a work recently published by M. Le Play, cannot fail to be read with interest by the members, the more especially as the work, from its size and price, is not likely to be in the hands of many.

Sir,—The man whose energy and surprising activity finally succeeded in bringing out triumphantly the Paris Exhibition, which, in its first stage, threatened to become a failure; the man who again stamped a peculiar character on that grand rendezvous of European industry by throwing open a gallery of cheap articles for the use of the labouring classes, that same man now lays before us the result of twenty years' arduous labour and research in his important work, intituled, "Les Ouvriers Européens," or, the "Workmen of Europe."

Those who are personally acquainted with M. Le Play, at first sight find it difficult to realise how he can have found time for the deep and complicated investigation of such an extensive subject. Himself a celebrated metallurgist, a no less eminent engineer, constantly entrusted by his Government with affairs of a most absorbing nature, one is tempted to ask, How can this writer have commanded data and information sufficient to present us with a most astonishing compendium of both the moral and material condition of the labouring classes throughout all Europe.

And yet so it really stands; for the work now before us already ranks single and supreme, of its kind, in the world of social economy.

The general character of the *Journal* does not allow of a critical review of M. Le Play's work; I shall therefore confine myself to a summary sketch of its contents. Our Mechanics' Institutes might find therein abundant materials for many an interesting lecture, which cannot fail to elicit sympathy from the audience, in proportion to the invaluable information the latter would derive therefrom.

"The two extreme regions of Europe," says M. Le Play, in his Introduction, "offer to the eye of an observer a spectacle of a very different character: whilst the northern and eastern populations continue to live on in a state of general contentedness with their lot, and a sort of quietude, which strike every intelligent traveller; the western populations, on the contrary, under the impulse of necessity, or the stimulus of excitement, are ever agitating for alterations in their habits and institutions. The researches which have given rise to the present work go far to prove the truth of the above statement or fact—a fact predominant, in many respects, over the social problems of our times. The comparative situation of these two populations shows itself more particularly conspicuous in our *Atlas*, wherein no less than thirty-six monographs bring forth the real condition of so many agricultural and industrial artisans. These thirty-six types were studied and investigated in every country throughout Europe, and certainly throw some light on the special character of civilisation in this part of the world; but, above all, they supply the reader with a series of precise results concerning the relative welfare of the various European populations, thus giving us a clue to the singular contrast above alluded to.

"The welfare of a family belonging to the working classes rests, in every grade of civilisation, upon two essential foundations: labour, which procures a livelihood; and foresight, which regulates the disposal thereof. Now, the love of labour is frequently found to be wanting in a rude state of society; and foresight is a still rarer occurrence. Nay, even among such nations as general opinion and incontrovertible symptoms place at the head of civilisation, the above virtues are but imperfectly developed in the multitude, so that these societies could not even maintain their existence, did not both their institutions and manners compensate, in a degree proportioned to the imperfect condition of the improvident classes, for that very insufficiency of individuals. This latter obligation is so truly imperative, and the labouring classes lapse into such a violent situation as soon as it ceases to be fulfilled, that the several measures adopted for its fufilment, form, indeed, in every country, the most striking feature of the social system. In this respect, Europe, with her numerous sub-divisions, presents three ruling *régimes* which have been successively realised in the history of the most advanced nations, just the same as childhood, youth, and manhood, follow upon each other in every individual existence.

"The *régime* of *forced engagements* or compacts, which prevails among such populations as are labouring under a low state of moral development; a *régime* which requires, in the upper classes and in the government, the smallest display of ability; and which, in fine, viewed merely in a practical light, may be considered as the most simple and most efficacious of the three systems, consists in leaving but a narrow scope to the free will of the working man, and in laying upon the master's shoulders the full responsibility of his welfare. This state of things, which has been illustrated in the present work by several remarkable instances, reigns in one-half of Europe, but especially in Russia, in the Sclavonic provinces of Turkey, and in Central Europe. According to this system, the workman is bound to accomplish the labour, on certain conditions determined by law and custom. But, on the other hand, the employer or patron is equally bound to foresee every eventuality, to provide for all the wants of the artisan and of his family, by bestowing upon the latter a downright legal mortgage upon the produce of his labour." (p. 9.)

It would be a very false idea to suppose, continues the author, that, under this system of compulsory engagements, the population is discontented with its lot. Wherever this social organisation is not vitiated by a laxity in morals, and as long as the employer duly fulfils his obligations, the workmen evince a strong attachment to their condition, and a no less strong aversion to any alteration.

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* *Les Ouvriers Europeens.* Par M. Le Play, Commissaire-General de l'Exposition Universelle· Paris, Capelle, 1855.

The second system or *régime* consists of *voluntary and permanent engagements.* It prevails throughout many countries of the North, the West and South of Europe, where it evidently implies an extensive development of individual liberty. They are invariably founded upon a long succession of tutelary influences over the labouring classes, upon the love of labour, and upon the enjoyment of certain advantages compatible with the welfare of a well-organised family. But within the bosom of no nation whatsoever can certain protective institutions be totally dispensed with; for these seem naturally to pave the way to that complete liberty towards which modern nations are now progressing. Such institutions are numerous in many countries of Europe; in general, they are the offspring of custom and tradition, not of positive law, and appear to form the true foundation or ground-work of European society. With this system, the conditions protective of the welfare and security of the working man are no longer imposed by law; but each family gratefully inherits the traditional order, handed down from generation to generation, conformably to the prevailing tendency of national character and laws, but above all by the benevolent disposition of the proprietor or industrial employer. In the eyes of M. Le Play, this *régime* is the best, the most congenial to the noblest instincts of mankind, the most favourable to that progressive movement so truly characteristic of modern society. We hasten to add that our author bestows upon England the praise of realising better than other nations the ideal of this superior system of voluntary and permanent compacts between the working man and his immediate employer.

The third system of compacts between the employer and the working man is of a transitory nature (*engagements momentanés*). The propagation of democratic principles having produced its natural effect of weakening the influence of the upper classes, the lower ones are under the obligation of providing for themselves. In some European countries, such as Norway, Switzerland, and Spain, the transformation from one *régime* to another has been accomplished without giving rise to a decline in the national character, or even with positive advantages for the people. The principal causes to which this phenomenon is attributable, are a large proportion of parochial lands and commons belonging to the people, and the co-existence of sound municipal institutions. In other countries, on the contrary, such as England, France, Belgium, and the North-west of Germany, the establishments of the temporary system has done away with the old habits of patronage, and completely altered the character of both classes. The most striking feature of the new *régime* may be seen in the sudden agglomeration of artisans and workmen in the neighbourhood of the coal-mines and factories which abound in the above-mentioned regions. In these great marts of industry, the master and the workman soon become total strangers to each other; their only connection is of a transient nature, and they feel utterly free from any mutual obligation. Sometimes even we see the workman abjure the blessings of a sedentary life as well as the most positive conquests of civilisation; he is no more attached to the workshop where he finds employment, to the house he inhabits, or to the place where he was born: nay, more, in some cases, he relapses even into the habits and customs of nations far below the scale of European civilisation. But too often do these nomadic tribes of a new cast fall beneath the latter in point of morality; and the official returns bear evidence that this inferiority is accompanied with circumstances most afflicting for humanity.

Hence the necessity for reforms in the the latter system, many of which indeed have been already attempted. But, unfortunately, none of these attempts have been sanctioned by experience, and they have thus proved abortive: more or less they have every one of them turned out to be the offspring of theories *à priori*, which would not bear the test of facts. The exponents of those social theories generally maintain that the cause of this non-success lies in the selfishness of those who govern society. But here again the impartial observer must needs be struck with the fact that, throughout all Europe, there does not exist one single government systematically disposed to discard any one amelioration called for by public opinion. On the contrary, the positive cause of sterility among statesmen in their initiatory measures of reform is precisely the want of unanimous support on the part of public opinion, pointing out with certainty the road on which Society is to progress. Even in our days, no less than in the past, ignorance and prejudice still carry it with a high hand.

However, it must be admitted that no European society remains inactive in regard to social reform; many partial attempts have been crowned with success, and that very success has been hailed with universal approbation in proportion to its being grounded on the practice of other countries.

But, if such be the case, what is this but a phenomenon similar to what took place in the natural sciences. So long as their adepts laboured in the field of theory they were stationary; but as soon as, under the guidance of Bacon, they applied themselves to the observation of facts and to experimental philosophy, as soon as emerging from preconceived notions, men came to have a definite idea of the weight, measure, and image of an object, they made rapid strides in the scientific world, and, to their great astonishment, were enabled to point out the theoretical laws by which the universe is governed.

Now why not apply the same system to the study of social organisation? Why should we not investigate the leading *facts* by which the labouring classes are distinguished, before we lay down any particular theory? Why, again, when speaking of what a government ought to do concerning industry, and the direction of those same classes, why should we decide, according to certain preconceived notions, upon the all-important questions of wages, state interference, the artisan societies, or upon any other exclusive organisation of the body politic? Evidently, the only method to be followed in this case is to approve any one of two systems which, in analogous conditions of practicability, favours to a higher degree the morality and welfare of a family, as well as the mutual affection between masters and workmen. Thus, for instance, the measure of appreciation applied to that morality and welfare must be certain facts, the importance of which are universally admitted. "Thus we may affirm that a family is in a good condition when its head is moderate in his tastes, just and affectionate towards those who are dependant upon him; when he finds in a regular sort of labour sure means of a livelihood; when, again, his wife, equally faithful to her duties of a spouse and a mother, maintains order and cleanliness at home; when the children show themselves respectful towards their parents; when all, in fine, yield to old age, to the infirm and to the sick that share of respect, affection and care, to which they are entitled. Every new system of organisation which would endanger the security of the family, or tend to weaken the above virtues, must be considered as defective, however it may, in other respects, be conformable to the general tendencies of civilisation."

Such is the scientific basis on which Mons. Le Play establishes his important work:—a direct method of observation applied to the different classes of workmen throughout Europe. The reader may see already that his method bears a strong resemblance to our own system of parliamentary committees and reports, which has had so many fruitful results in our country. Indeed, we shall have more than one opportunity to observe that the author evidently has a bias in favour of the English organization of society. From such a man, a tendency of this kind is no small praise, and ought to make us proud of our constitution, in spite of all its faults and deficiencies.

Here the reader will doubtless inquire by what means M. Le Play was enabled to investigate, through the method of *direct* observation, the condition of the working men throughout all Europe. To this we may reply that his official station as an eminent metallurgist in France, and as a professor at the Government *Ecole des Mines*, has furnished him with means refused to many. His travels on the continent for scientific purposes have been, more or less, continued during the last twenty years, a circumstance which put it in his power to gather a mass of evidence concerning the labouring classes of each nation far beyond the reach of the resources of a man in ordinary circumstances: whilst, on the other hand, he has sifted that evidence with a degree of precision belonging to scientific men alone.

The preceding lines contained what may be termed the preliminaries of M. Le Play's work; afterwards he enters fully upon his subject, and the reader follows him with interest. Fully aware of the importance of precise definitions, he first proceeds to state what he understands by the term *workman*, which, he says, does not convey the same meaning to every mind, and in every language. This brings him to establish the following definition: *A workman is a person accomplishing manual labour of any kind other than that resulting from attendance on the person of the master ; and who partakes more or less of the condition of a proprietor or industrial employer, and whose principal means of existence arise from the remuneration granted to his labour.*

This comprehensive definition enables the author to include within the reach of his researches the nomadic tribes of the Oural, or the peasantry of Wallachia and Hungary. no less than the civilised artisan and mechanic of cities like London or Paris. Upon this same definition, he likewise establishes his investigations relative, 1. To the organisation of the family in the four social systems of Europe ; 2. To the organisation of communities and corporations; 3. To the systems of patronage adopted in favour of the labouring classes; 4. To the different characters which more particularly distinguish those workmen who have the entire enjoyment of their free will, and the manner in which they spread gradually throughout our part of the world. When speaking of the latter subject, M. Le Play is led to the following conclusion :—

"If we do not suffer ourselves to be led astray by any secondary consideration—if, according to the method laid down in the present work; we sift things to the bottom, we shall soon find that all the sundry varieties of the labouring classes may be definitively reduced to two grand types; the first type (alas! but too rare in our actual state of civilisation), including such workmen as are supported by a feeling of foresight and providence, and constantly tend to acquire property by means of their savings, thus gradually engendering a revenue which increases their resources. The second type, by far more common, consists of individuals obeying an opposite tendency, who consume beforehand the resources they are to receive, live upon credit as long as it is not withheld, and know of no other restraint but necessity. At the very first glance into domestic life, as soon as we begin to draw up the budget of a family, in every detail of its existence, we immediately discover either the one or the other of these exclusive tendencies."

The importance of the above data has induced M. Le Play to enter into the most minute details concerning the workman's budget of receipts and expenses. He devotes a separate chapter to every one of the following heads: 1. The different sorts of property a workman may possess; 2. The three species of subventions or reliefs to which he may be entitled; 3. Considerations upon the labour and salary of every member in a family; 4. Of the various kinds of industrial occupations undertaken by working families, and of the profits resulting therefrom.

The expenses are again divided into four sections, including food, habitation, clothing, expenses relative to moral wants, to recreation and health, expenses relative to the profession, debts, taxes, and insurances of the working man. To enlarge on these highly interesting subjects would occupy too much space; a brief sketch of their contents is all that can be given. Thus, under the title of Food, the author examines closely and scientifically the influence of different sorts of vegetable and animal food over the constitution of the working man. The reader is not only interested, but gains a stock of excellent practical information, after perusing what the author says about corn and its numerous varieties; about milk and eggs; about the different sorts of meat and fish; about the wonderful applications of the vegetable world when used by the labouring classes; and lastly, about the various species of fermented liquors consumed as beverages.

Of a still higher character is the section devoted to the moral wants of the labouring classes. With the keen sight of a man who has long studied them as an eye witness, and with the indulgent heart of a Christian, M. Le Play attaches the greatest importance to the preservation of religious feelings among those who fully enjoy the exercise of their free will. He proclaims it an affair paramount to any other; whilst he hardly ascribes less importance to the question of popular education, and especially appropriated to the wants and feelings of the working man. The following passage, relative to the influence of religion among the labouring classes, will be read with interest:—

"Unfortunately," says our author, "when man is left to his own natural impulses, he is seldom so happily endowed, that a modification in his feelings and habits corresponds with a progress in his social condition. Any individual gifted with energy sufficient to overcome a multitude of obstacles in order to attain the position of a landowner, or a manufacturer, will seldom find within his own breast the moral resources necessary for the practice of those virtues which his newly-acquired station requires. Those social systems which have impressed the deepest stamp upon the history of Europe, and have borne nations to the highest degree of prosperity, are grounded upon two opposite principles, though equally consistent with human nature. The former of these systems endeavours to maintain as far as possible the stability of the body politic, and confides the guardianship of the lower classes to certain families, among whom the feeling of this duty, enforced as it is by custom, is handed down from generation to generation. The latter system, on the contrary, proscribes every kind of hereditary classification; within its precincts, every eminent individual, whatever may be his origin, is allowed to ascend every step of the social hierarchy, and society itself is subjected to a direct pressure of such a nature, that the notion of duties to be fulfilled towards the lower classes, impresses itself upon individuals in proportion as they rise to a higher grade. In the former societies, order is maintained through feelings of honour and duty, through that antique motto of the French aristrocracy—NOBLESSE OBLIGE; in the latter, it owes its maintenance to the power of religion. The superiority which Europe seems daily gaining, may be attributed, one would think, to the circumstance that her several social constitutions become less exclusive, and borrow from each of the above principles their most beneficial consequences. The societies which are the most successful in combining progress with the conservation of order, are those where the influence of religion is predominant, where the great social virtues do not cease to form a noble inheritance of certain families, whilst eminent individuals, whatever may be their origin, are not debarred from rising to the very first ranks.

"These observations would require, doubtless, to be more fully developed, were it within our compass to insist upon the moral condition of the upper classes; but they are sufficient to conceive the part which religion has to play, when considered in her relation with the economy of society, in the emancipation of the labouring classes. She favours the development of foresight among the inferior types, by curbing their grosser instincts; she exerts over the eminent types a still more beneficial influence, by animating them with an energy they would seldom find within themselves, and by securing to them those moral resources so highly necessary to prevent the exaggeration of the above virtue. Religious feelings form the natural balance of such habits, as are engendered by a constant straining of the mind towards lucre and economy; they initiate the workman to the new duties implied in the passage over to a higher station. In order to estimate the true value of the progress made by the labouring classes, it is therefore necessary to ascertain whether the development of religious feelings advances apace with the tendency to providence. In this respect, one of the most decisive symptoms is the coexistence of a strong disposition to economy, and of a tendency to relieve by alms and donations such persons as have fallen into a state of destitution. This is the reason why we have devoted a special paragraph to this sort of outlay in the 4th section of our budget."

Hitherto, we have been accustomed to look upon the numerous and motley populations which inhabit the Russian Empire as one great mass of the human species condemned to wretchedness and misery. The narratives of travellers, the data furnished by economists, the information supplied by diplomatists, and last, though not least, the events of the present war, have taught us to consider the forty-eight millions of the Sclavonic race that live under the Czar's sceptre in Europe as little better than barbarians. Our feelings and opinions in this respect are probably of the same nature as those which animated the Athenian or the Roman when speaking of nations not included within the range of their splendid enlightened civilisation.

In some respects, this feeling is perfectly correct, and founded upon positive facts; the writer of the present lines has himself seen enough, during a long residence in Eastern Europe, to bear witness to the accuracy of the above-mentioned statements. But, like all sweeping assertions, it allows of many restrictions; nay, one may even affirm, with no less truth, that the Russian workman generally enjoys as much happiness and welfare as his state of society and civilisation can admit of, or much more than a very large proportion of our Western artizans. Indeed, this assertion is not confined to the Sclavonic races, but may be equally extended to many German populations of Central Europe.

This may be startling, but it is at once the duty as well as the merit of works such as the one before us to lay down facts as they really are, to show truth in its nakedness, and above all, never to cater for popularity by flattering the passions of the day.

Besides, after a close and minute perusal of M. Le Play's work, and more especially of his tabular evidence, the reader rises from the book with the following conclusion, which forces itself, will or nill, upon his mind:—

The labouring classes of Northern and Eastern Europe are efficaciously protected against their own improvidence by the care and solicitude of the upper classes. Whatever may be their misfortunes, they are sure to find help and protection in their lord against the casualties of life, and to transmit their small earnings to the children of their children, even supposing their mite not to be increased by care and industry. On the other hand, self-dignity and individual effort to rise in the scale of society are rare occurrences,—exceptions seldom to be met with. This is precisely what one might have expected in a system wherein serfdom prevails.

In Western and Central Europe, on the contrary, everything is left to individual industry and enterprise. The man endowed with a strong will and eminent faculties of the mind, is almost sure to soar above the level of his fellows, whatever may be the untoward circumstances of his condition when he starts upon the road of life.

Such a system is highly favourable to the development of self-government and dignity; it corresponds with a high standard of civilisation. It thus ranks far superior to the former system—a system that may be likened to the infancy of society. But again, the Western system gives rise to evils of a most serious nature; by its very tendency to individualisation, the labouring classes are generally deprived of that benevolent patronage which doubtless falls in with the designs of a wise Providence. Thousands of human beings accumulate around large factories, or within the walls of immense cities, where but too often misery and loneliness await them at the very first accident which befalls them.

That revolutions should break forth,—that a ruling discontent should be the result of such a state of things,—is by no means surprising. Hence the stringent necessity for the upper classes to assume of their own accord a protective power over the improvident and labouring classes,—a power or system in which freedom and individual energy may be allowed free scope, but wherein the disastrous consequences of extreme destitution and isolation would be effectively neutralised. The field is wide enough to call for the display of talents of the highest order and of every description. Above all, we must have no theorising, no Utopia; facts and experience alone must win the battle on which depends the very existence of our boasted civilisation.

The first tribes to which M. Le Play devoted his attention, were the half nomadic Baschkirs, who inhabit the Asiatic slope of the Oural. The village of Mochmet, where he began his investigations, is not far from Ekaterinenburg, one of the most celebrated regions in the world for its mineral riches. The Mahometan inhabitants of the village are partly employed in the gold-washings, partly in those pastoral occupations to which the surrounding scenery and pasture grounds are so highly favourable. Hence, their innate passion for the nomadic life, and for that state of vacant repose, so highly characterestic of eastern habits and manners.

The Baschkirs, in consequence of the latter passion, seldom rise to the possession of riches; but they find a compensation in the enjoyment of an extensive territory, which is possessed undividedly by the whole tribe; and in the social organisation of the family. A state of indigence, such as that often to be met with in Western Europe, is utterly unknown. At any rate, abundant means of sustenance offer an easy resource to those who may suffer from temporary distress. Their fortune may be valued according to the number of wives, mares, cows, and other cattle belonging to the head of each family. The village of Mochmet includes altogether seventeen houses or families:—now the table drawn up by the author, shows that the richest man of the place had four wives, six mares, four cows, and a tolerably large number of sheep; but then he was a substantial burgher.

One of the most remarkable circumstances of Russian life in general, is the fact that, the different members of a family continue to reside in the paternal dwelling, even after the sons and daughters have entered upon the marriage state. Instead of separating, as in Western Europe, and forming so many individual communities, but too often unknown, if not even hostile to each other, they continue to live under the same roof under the authority of the STARCHI, or ancient, who rules over the whole community, like the patriarchs of old. His authority reigns undisputed within his little circle, and his faculties tend solely to employ every member of the family so as to increase the common weal. In consequence of this custom, the family association frequently acquires a degree of independent fortune of which our artisan families would hardly dream. The same rule prevails among the Baschkirs, whose erratic habits are, however, opposed to a mode of existence essentially grounded upon a sedentary life. At the same time, M. Le Play observes, that the very leisure attendant upon nomadic customs, gives birth among certain highly gifted individuals to meditative powers, to a distinction of manners, and even to an acuteness of intellect which is seldom to be found in the same class throughout our own western world.

In regard to the Russian peasantry, its condition may be generally assimilated to the description which the author gives of a family residing upon an estate in the steppes of Southern Russia. The case would not be, however, the same, when speaking of the peasants inhabiting the western parts of the empire, where their condition is far more degraded and liable to oppression.

"The whole family we are speaking of, says M. Le Play, was brought up in the Græco-Russian form of worship, and punctually fulfilled their religious duties, conformably to tradition, to the impulse of a lively faith, and to the prescriptions of the laws. In this respect, they are precisely upon the same footing as all Russia.

"These dispositions are rather the result of instinctive faith than of any rational development of religious feeling: they do not preserve the members of the family from an inclination to drunkenness, to dissimulation, or even to fraud in money matters; but, on the other hand, they inspire the Russian peasant with a stoic resignation in his moral and physical sufferings; they contribute to maintain a deep feeling of respect towards parents; in fine, when death comes on, they strengthen his soul with a degree of security and serenity which at times attains a character of veritable grandeur.

"Women do not seem to breathe a deep feeling of chastity; however, parental authority, combined with early marriages, contribute to the preservation of good morals. The patriarchal constitution of the family, the great security arising from the protection of the land, no less than the abundant resources as to living which every family has at command, stamp the social intercourse with a certain propriety and dignity seldom to be found in the same class at the other end of Europe. The religious festivals and family anniversaries give rise to frequent meetings between friends and relatives; on such occasions, hospitality is proffered and practised upon even a munificent scale. Many families, by taking advantage of the *abroks*, rise gradually to a large fortune; but their order and economy never degenerate into sordid avarice, nor induce them to forget the obligations of each head of a family towards his children, friends and municipality.

"The relations between the peasantry and their lord are of the best description; they are strongly marked by that feeling of respect and familiarity shown by children to their father. There are no instances of that hostility between conflicting interests which are so frequent in Western Europe. The landowner never denies the peasant his right to a certain quantity of arable land, to pasture ground, to forest wood, and even to the chase. Oppression and violence are always an exception; the lord's authority, far from weighing heavily on the peasant, forms a foundation for the preservation of property, and the maintenance of a patriarchal organisation. This happy state of things arises from excellent traditions, themselves grounded upon a deep sentiment of equality, upon unity of race, and religion."

The *abrok*, which the author alludes to in the above passage, forms one of the most striking features of the Russian body politic. Throughout the whole of the north, the west, and the south regions of the empire, where the soil repays but indifferently the toils of the labourer, and where a population relatively dense successfully turns its activity to manufacturing and mining interests, the landowners usually give up to the peasantry the whole land and employment of their own time, on condition of paying an annual tax called *abrok*, or capitation tax. It is somewhat similar to our system of land rent, from which however it differs in one essential feature. The *abrok* is indeed a collective tax, falling not upon individuals, but upon the parish or commune, the local municipal corporation undertaking to assess its distribution among the heads of families.

The industrial population of Russia, who mostly contribute to supply the manufactures and sundry crafts of towns and cities with the necessary artisans, are almost exclusively subjected to this system of *abrok*. Though bondsmen by birth, and continuing to be so, they enjoy great personal liberty, thus being enabled to choose their own occupations, provided they are punctual in paying to the lord their trifling share of this yearly rent. Neither a prolonged absence, nor a large amount of profit, prevents the itinerant workman from returning to his family; on the contrary, the authority of his father, combined with the obligations due to his lord, and a sort of instinctive fear of abandonment and isolation, all tend to bring him back to the small community to which he belongs.

The industrial artisans who are employed by the lord himself in the mining districts, form a distinct class, described minutely by M. Le Play in his 4th and 5th tables. Though, in some respects, these mechanics bear a strong resemblance to those of our own part of Europe, still they differ from them in the fact that, in case of misfortune, they are ever sure to find support and relief in the landowner, who considers this a part of his most serious obligations.

In the rich and fertile provinces of the south and the east, where hands are wanting for the labours of the field, the landowner merely portions out a part of his estate to the peasantry for themselves to live upon, whilst he cultivates the rest and turns it to account for his own purposes. In return for this grant of land, as well as for the house and garden he inhabits, which are rent-free, the peasant is obliged to till his lord's land and fulfil the usual employments of an agricultural labourer at least three times a week. This numerous class of peasantry may be assimilated to the *natives* or villeins of the middle ages.

It would take too long to follow the author into all the interesting details furnished by his tabular evidence, wherein every item of account is made to bear in order to show what really is the moral and physical condition of the Russian workman. We must now hasten to other countries.

The North of Sweden is celebrated for iron mines and factories, which are reported the best in the known world. Among these, the Dannemora mines stand prominent, contributing in a large proportion to supply England with that ore of superior quality which enables her steel cutlery to compete successfully in every market of the globe. The ore of iron is treated with charcoal in about ten factories, situated in the immediate neighbourhood of the mine. As the winter season is the most favourable, like in Russia, for carriage and land communication, the products of the furnaces are transported on sledges to the small ports of the coast, from whence they are sent in the spring by sea to Stockholm.

The labouring population consists mainly of tenants, of small landowners, and artisans bound to the mines, factories, and furnaces, by temporary engagements, but which are in reality continued from generation to generation between the parties. Here every man enjoys his own free will, and yet all are so bound to the patron that the character of the tenure may be considered as voluntary and permanent at one and the same time. To every factory is annexed a considerable extent of arable land, on which the proprietor has a certain number of tenants. These pay the rent of their farms by supplying so many days' labour throughout the year for hewing wood, for the converting it into charcoal, and conveyance to the furnace, and, lastly, for the cultivation of the patron's land. The principal element of prosperity in this social organisation, common to all Sweden, lies in the intimate connexion existing between the employer and the workman. The latter is insured against all casualties, by the kind and enlightened interference of the former. It is certainly no feeble argument in favour of the Swedish system, that from these semi-agricultural semi-artisan tenants are chosen the *peasant*-deputies, who are so truly remarkable for their patriotism and sound good sense in the national parliament.

"The condition of the Swedish workman," observes M. Le Play, "is a most interesting subject of investigation, as it offers a sort of transition between the compulsory system of Russia, and the voluntary system of engagements adopted throughout Western Europe."

"All artisans and labourers in Sweden enjoy the free command of their own persons; it is an acknowledged principle that they are utterly independent of the proprietors and industrial employers for whom they labour. In reality, however, they are always bound to the latter by traditions and by a complicated system of public or private institutions. Hence arises between the different classes a union which is equally satisfactory to every interest; which secures to the master both the respect and affection of the workmen, by ensuring no less to the latter a benevolent patronage in case of disease, old age, insufficiency of labour, scarcity, or other public evils. That security of subsistence, which is the very first claim of a labouring population, and which is guaranteed in the Russian system only by sacrificing individual freedom, is in this country the natural result of habit, and the national manners. Favoured by this salutary impulse the Swedish workmen have attained a most remarkable degree of morality. No less favoured by the large quantity of land at their disposal, and by the institutions of their country, they often obtain, through their labour and economy, the means of purchasing property. Thus is constantly recruited among the employers and the artizans, that fourth order of landed proprietors belonging to the peasantry, whose influence is daily increasing. The Swedish peasant, having once reached the first rank of landed interest, frequently forms unions, similar to those known in the middle ages, for the prosecution of such enterprises as elsewhere tend to become the exclusive monopoly of large capitalists and rich companies.

"The Swedish women, belonging to the labouring classes, are, in some respects, superior even to the men; they are generally distinguished by a certain graceful demeanour, by a graceful attire, by the care they take of their head-dress and hands; in fine, by the moral qualities and esteem which they enjoy. This superiority of the female sex is the consequence of a time-working tradition in regard to virtue, and of excellent social habits. In many provinces of Sweden, the workmen show their wives and daughters the same attention, the same kindness, which elsewhere are the peculiar inheritance of the upper classes. Females are usually freed from degrading occupations, or such as are incompatible with their sex. In Sweden, it is a rare occurrence to meet a woman carrying on her back a heavy burden, as is frequently the case in France and Germany. Rarely, likewise, does a woman leave her domestic circle, at least in those branches of industry which are most essential to the development of the national resources. The moral and physical condition of women is far different in Stockholm, and more especially in the cotton mills lately established in central Sweden, under the influence of companies ruled by the financial combinations and technical processes of British industry. The investigation of these new-born centres of production is a good opportunity of showing the perils attendant upon the new economic *regime* which now prevails in the most important states of Europe,—a *regime* which England herself has found necessary to modify by the introduction of energetic reforms.

From the above quotations the reader might be disposed to believe that M. Le Play prefers the social organisation of Northern and Eastern Europe, to our western civilisation. Such a conclusion would be erroneous; his object is merely to show the urgent necessity for our feudal and manufacturing lords to undertake, in favour of the labouring classes, a system of patronage somewhat similar to that held out by our ancestors in times of old. The better to elucidate his purpose, he has devoted two of his monographs to the moral dissection of the Geneva watchmakers. After showing how that class of artisans formerly enjoyed many privileges and resources equally favourable to their bodily and mental condition, he contrasts that condition with their present state, which is a life of improvidence and penury. And yet, adds he, there is hardly any population which equals the Genevans in regard to morality, economy, and self dignity. They frequently undergo the most painful sacrifices, in order to secure to their offspring the blessings of a sound moral education. Thus, their misery can by no means be ascribed to their vices or degradation. He then concludes with the following observations:—

"The facts stated in the two preceding monographs (18th and 19th), when contrasted with those included in our ten first, will supply the elements of a comparison between the highly different civilisations of the East and West.

"It is more especially by the depth of religious feeling, and by the moral consequences accruing therefrom, that the Genevan artisan, as well as many other types belonging to the West, are decidedly superior to the best workmen of the East, however well disposed they may be to fulfil the ordinances of Islam, or of the Christian religion.

"The favourite amusements of the Genevan artisan reveal, perhaps better than anything else, the pre-eminence of his moral qualifications. In summer, his great delight is to stroll, in company of his wife and children, through the picturesque scenery which surrounds his native city. The behaviour of each family is constantly marked by a feeling of propriety in all places of public resort; it even forms a striking contrast with what may be observed, on similar occasions, in other countries. In winter, a good workman usually passes his hours of leisure in some society of which he has become a member, and, when he can, attends public lectures liberally given by persons devoted to the progress of the labouring classes. Family readings are likewise considered as an essential source of domestic amusement, particularly by women and the youth of both sexes. Almost every household can boast of a small library; besides, it is an easy matter to hire books at a very trifling expense. This habit of reading, though not always commendable in regard to the works selected, proves, at least, that the Genevan mechanic is not ruled by sensual appetites, or by those propensities which, in the greater part of Europe, place the artisan far below the middle and aristocratical classes of society.

"Meetings of friends and relatives, an exchange of presents on certain family anniversaries, and which usually consist of articles of dress and furniture, form also a striking feature in the habits of the labouring classes at Geneva. The Genevan artisan ever tends to imitate the manners and habits of the *bourgeoisie* placed immediately above him. The details upon which we have entered bring forth the moral advantages of such a tendency; however, the workman frequently goes beyond the limits prescribed by reason and foresight. The evil consequences of this deficiency are illustrated in the youthful couple we have spoken of in the eighteenth monograph. No doubt that improvidence under this form, though grounded upon estimable qualities, may lead to results no less fatal than vice or intemperance; but still these inconveniences, arising out of civil equality, are more than compensated by the moral advantages we have alluded to.

"All observers who will methodically investigate the condition of the labouring classes in Europe, must ever acknowledge the superiority enjoyed both in the north and the east, in regard to material security and welfare. These abundant means of subsisting are indeed the leading trait of Oriental civilisation. By comparing the ten first monographs of the present atlas with the lamentable descriptions published of late concerning the artisans employed in the manufactories of Western Europe, we are forcibly led to ask, whether the wonders of human industry, purchased at the price of such acute suffering, do not in reality mark the commencement of a decline."

After anxiously putting the question under various forms, the author addresses the following reasons for answering it in the negative:—

"The qualities observable among the labouring classes of Russia and other eastern or northern countries, generally originate in a certain number of external conditions independent of individual free-will. If, for instance, a good workman is not addicted to drunkenness, it is because his lord places at his command such ample means of subsistance that hardly any room is left for the display of brutal appetites. Again, if the same artisan labours with assiduity, it is because a severe discipline, founded upon routine, upon local regulations, and even upon the law, protects him against the temptation of idleness. The Genevan workman, on the contrary, is bound by no fetters; his virtue, of a less passive character, does not exclusively depend upon external circumstances:—it is within himself, within the sanctuary of his own reason, that he finds energy sufficient to restrain his passions and fulfil his duties.

"So that by studying the condition of the Genevan artisan, we are brought to the conclusion, that the impluse given to western civilisation is really a progress for humanity. Other instances which occur both in France and England, will serve to refute many a paradoxical position relative to the deplorable condition of the labouring classes. The rapid strides of industry, as well as the development of individual liberty, by no means bring along with them the necessary degradation of the human species. Every religious society that knows how to regulate the movements by which western nations are hurried along, will be able to effect much good without the alloy of those evils too frequently marked at present as its fatal concomitants."

The reader has now before him a number of examples sufficient to show what method the author follows in the investigation of his subject, as well as the highly interesting results to which that method forcibly brings the observer.

The limits of my letter will not allow me to continue the quotations; though Spain, Italy, France, and England, would supply ample interesting materials. I must, therefore, hasten to the appendix, in which M. Le Play produces his conclusions. These are of such high importance, and so peculiarly fitted to the usual habit of mind among British readers, that no apology is needed for giving them rather fully at the close of this letter.

Of late, the law of succession, which, in France and other countries ruled by the civil law, enables a parent to divide his property in equal shares, has become the subject of numerous comments and strictures. Among the French, statesmen, and even lawyers, begin to open their eyes to the pernicious consequences gradually wrought by an indefinite division of land. It is no rare occurrence among our neighbours to meet with people who bitterly complain of a system, which constantly engenders a whole army of needy place-hunters, whilst it places at the mercy of a young spendthrift the treasures that have required long years of labour and industry to provide for future generations.

It is certainly no insignificant circumstance, that a man, so truly guarded in his opinions and language as M. Le Play, should enlist on the side of our English system of entail. But so it really is; to arrive at such a conclusion he must doubtless have overcome many a prepossession in his own mind, but above all the traditions and notions he was taught to hold sacred in his childhood.

After drawing a faithful picture of both systems, the author is led to the following observations, which ought to sink deep into every thinking mind.—

"Both of the above systems were fully represented in the old French constitution; but our revolutionary assemblies, forcibly struck with the abuses arising from the system of entail and mortmain, and no less impressed with notions concerning equality and natural rights, were apprehensive that, by upholding the right of bequeathing property, parents might obtain too great an influence over youths, and thus endanger the new social system. This naturally led them to consider any powerful organisation of the family as a bar to real progress. Besides, upon referring to the debates which preceded the laws of 1790, 1791, and 1792, as well as to the deliberations to which the *code civil* gave rise, it is easy to show that this new law of inheritance, or, in other words, the very ground-work of actual society, was enacted under the impulse of the moment, and without any previous inquiries, such as are looked upon in England as essential preliminaries to the most trifling reform in her institutions. Thus it was that our lawgivers, yielding to an exclusive bias which is condemned by the very principle of European civilisation, abruptly ignored the national tradition. Thus did they all but completely abrogate that right of bequeathing previously enjoyed by our southern provinces, as well as the sundry modes for transmitting property in its entirety, established in favour of the nobility, and appropriated to the other classes by the municipal law of Northern France. But the new law proclaims a sort of fatalism in the opposite direction; it scarcely upholds the slightest vestige of paternal authority, by establishing an endless division of patrimonial property in a way no less exclusive than the old common law of Europe which favoured inequality and indivision.

"The practical rules laid down in this work for the due appreciation of the social movement, here give rise to doubts of a most serious nature: by these we are led to inquire whether France, as far as the social condition of the family is concerned, stands in the true road to civilisation. The law as to succession is the foundation of society, one main cause of its rise or fall: it must therefore become a matter of anxious scrutiny to ascertain the motives on which is grounded in France the maintenance of the present system, as also those tending to a modification of that same law."

After summing up in a most impartial and philosophical manner both sides of the question, M. Le Play is evidently of opinion that the prevailing system is fraught with consequences far more pernicious than could possibly arise from the contrary *régime*. But instead of impelling his countrymen to alter immediately their law in this respect, he merely winds up with the following modest, but judicious suggestion:—

"We propose an inquest upon our law of succession, an inquest which would be to France no less beneficial than was to England the inquest relative to labour in manufactures. It would bring about amongst us a salutary reaction, somewhat analogous to that which twenty years ago triumphed over the most inveterate opinions concerning social economy, and preserved England from an impending cause of disorganisation.

"The opportuneness of such an inquest may be likewise deduced from another order of observations. In the opinion of their own authors, the laws enacted in 1792 and 1803, were destined simply to obviate transitory difficulties. Besides, the illustrious author of the *code civil* soon acknowledged the necessity of balancing the fatal effects of the above laws, by certain institutions, which the cry for equality contributed afterwards to abrogate, so that in order to continue the traditions both of the revolution and of the empire, it would be advisable to ascertain whether those difficulties have not already passed away; whether property, now ultimately incapable of perpetual entail, ought not also to be freed from the pressure of forced division. Upon viewing the subject in this light, it is no difficult task to shew that the determinate motives of our law-givers have not lost their weight. Nobody will fear, for instance, that parents would use their long-lost influence to prejudice their children against all sorts of innovation; nay, it would perhaps be far nearer truth to affirm that such fears have now given way to prepossessions of an opposite nature. Thus, were it once proved that private manners, no less than social tendencies, have undergone due alteration, perhaps it would be high time to retrace back our steps, after fifty years of severe trials, to that progressive road which was necessarily closed, in consequence of the moral dissolution that stigmatised the eighteenth century. The law giver who shall be enabled to resume our old national tradition in this respect, without wounding our modern feelings, nor giving way to a retrograde spirit, that man will really establish upon the continent a new order of things, which so many noble-minded hearts hailed long ago in the grand reforms of 1789."

C. F. AUDLEY.

SOME REMARKS ON MR. J. K. BLACKWELL'S EXPOSITION OF THE IRON MANUFACTURE AT HOME AND ABROAD.

By David Mushet.

I regretted on Wednesday, the 9th of Jan., that time would not permit a prolonged discussion on this important paper, but your valuable *Journal* was referred to as a channel open to supply the deficiency; I beg, therefore, to forward a few remarks. I wish, indeed, so excellent a means was more used for discussing subjects which could hardly be adequately canvassed before midnight, especially when a paper is of such length as to require two evenings for its perusal. I quite admit that the jocose treatment of the matter by Mr. Bird and Mr. Kennard gave an exact picture of the *morale* of the iron trade in this country, but then the very question raised by the paper is, What are likely to be the ultimate consequences to our manufacture of the continuance of this sordid spirit? That the existing tone of society is in all things to do just what will suit the market, and no better, however bad the requirement, is, I agree, an undeniable fact. Books, for instance, are made on the same principle as iron, to meet a standard of quantity, not quality. "Fit audience find though few," would be just as unsuitable a motto at a bookseller's as at an ironworks; money has to be made, and, therefore, the *majority* must read and buy; novels and other popular works may be worse trash than the worst bad iron; even the muse of history has lately been descending to play extraordinary pranks to the call of the same trading requirements; therefore, much more as the uses of iron are practical, and very directly and easily tested, I do not see much harm is done by the making iron just as good as is wanted and no better, provided that this money-making rule of action leads ultimately to no worse consequences. The great question before the meeting was, whether this admitted state of things was tending to our permanent injury, and whether those nations who were alleged to be prosecuting the manufacture in a less regardless and more improving spirit, were likely to steal away by degrees our pre-eminence. Now I must confess that, laborious and intricate as were the details of Mr. Blackwell's communication, he hardly took that comprehensive grasp of the *comparison* in its main particulars, as to enable us to arrive at a definite judgment whether or not it will always continue in our power "to eat up our rivals off the face of the earth." We cannot form a correct opinion whither the present is leading us, without referring to the steps by which that present has been reached. We cannot pronounce upon the probable future, except by a distinct reference to the actual past. Our position of to day is but one item in a long account, which, taken as an isolated point apart from the rest, means nothing. The most microscopic examination of it will afford no light to the judgment. Even as to the present facts of foreign manufacture, the details were extremely meagre, in the absence of which, elaborate disquisitions on processes perfectly familiar at home, again baulked us of the materials of comparison. I wish we had seen a few large maps of the foreign mineral districts; they would have been a short-hand way of conveying far more effective information of the general facts, and with great economy of time, compared to an intricate verbal delineation. A map of France, for instance, as our greatest European rival, about three yards square, behind the chairman, tracing the edges of the several coalfields, and the main lines of rail which are to bring the produce into cheap competition, would have furnished solid, unevanescent data for our consideration, especially if accompanied with figures of the great alleged depth of these deposits as approximately as has been ascertained. Above all sections of those basins which were hinted at as containing veins of coal of enormous thickness; something tangible, if ever so little, to place in our minds as to their proportion, for instance, with the ten-yard coal of Staffordshire, or the forty-yard anthracite of Pennsylvania. Some facts and figures of the process of *mazeage*, which was recommended as our model, would have been a great addition to the practical value of the paper. Similar exact data of the results of puddling with the waste gases, which has for so many years been urged on us,—one of the foreign accomplishments which we despise,—would have supplied a great desideratum. I should like to have heard an account to date of the progress made by the foreign workmen in the *physical* act of puddling. An English puddler used to be able to turn out as much iron as two or three native foreign puddlers, and it is clear, so long as this disparity continues, it will secure to us the power of supplying cheaper iron at nominally much higher wages. In short, I was led to expect a full *exposé* of *recent* foreign progress, replete with new matter, but heard nothing but what was many years old. For instance, the machinery at Eschweiller, with which Mr. Blackwell seems to have made his acquaintance at the Paris Exhibition, was elaborately reported on in England in 1848, by one of our most eminent engineers. The use of muriate of soda in the puddling furnace, named as practised at Seraing, was patented by my late father *thirty-two years since*, at the time he was engaged in completing the erection of those Belgian works; the addition to it of oxide of manganese was patented by Mr. J. M. Heath, one of the numerous victims to the profound astuteness, the astounding refinements, the exquisite diversity of opinion, and the brilliant wit exhibited by some of our judges when a patentee in this country is asking for his own.

To arrive, then, at any sound opinion respecting the permanent character of our pre-eminence in the iron manufacture, it is absolutely essential to consider how we have advanced into the position. It is quite true, as admitted by Messrs. Bird, Kennard, and Davis, that our iron makers are acting on the principle of making as much money as they can, and, with that sole object in view, some of them have made a great deal, but this does not touch the question, How long shall we be able to do so at all risks with success.

The first grand cause of our position in the iron manufacture, is the extraordinarily copious diffusion, over so large a surface of our limited island area, of the coal and ironstone in felicitous juxta-position. This is the foundation of *what we have done*, and therefore, to know the foundation of what France (for instance) *may eventually do*, it was most essential that we should have had precise data as to that *thickness* which Mr. Blackwell considers will compensate its mineral deficiency in length and breadth. Our second great natural advantage is the proportionate extent of our insular sea-board, and the consequent proximity to it of our principal fields. Those more remote, though triflingly so, compared to the inland French districts, had, early in the last century, been prepared for the market by the system of inland navigation which Brindley instituted. Of this advantage Mr. Blackwell seems to think that foreign railway communication will deprive us; it may indeed tend to equalise past disparity, but it never can annihilate distance. Our third national advantage is the *quality* of our labour. How we are to explain the origin of this difference, may be a hard matter, unless we ask the astrologers, but certain it is that that sullen solidity which has distinguished the battle-fields of our present random shot, hap-hazard war, has had no small share in conquering, with better generalship, our mineral fields, and vanquishing the weighty legions of their produce in the strife of peace, at home. Last—but not least—must be enumerated the solid, self-relying energy of masters as well as men, an independent individual wealth and physical force of mind, fostered by that form of government which this native character has equally created. With these four natural advantages concentrated within our island area, superior mineral wealth, great facilities of transport, strong sinews of labour, backed by strong practical heads, with strong purses all ready for action, Watt's condensing engine rose into existence. This great invention immediately supplied the double blast-blowing apparatus. The one thing needful to furnish the breath of energetic life to our smelting furnaces continuously, with a power independent of seasons and situations, it imparted an immense impetus to the pig-iron manufacture. But one more gift alone was wanting to give vent to all our pent-up energies of nature and of art, and to launch us forth as the unlimited manufacturers of iron for the whole globe. This was a means of converting the plentiful pit-coal pig-iron, by the same cheap fuel, into a serviceable wrought iron, which might compete with the costly metal we drew from forest-covered countries, slowly creeping over the threshold of peopled civilisation. Here again arose, when he was wanted, another of those great practical inventors for vast and solid purposes, which have pre-eminently distinguished our own country—the right man at the right time. From the first development of the manufacture of pit-coal cast iron, our practical ironmakers had seen that it was the greatest desideratum to discover some means by which this cheap fuel could be used for a corresponding development of the wrought-iron branch of the manufacture. Numerous were the attempts, after 1750, to make bar-iron beneficially with pit-coal, but all had proved failures, when, in 1783 and 1784, Henry Cort perfected and patented *two distinct inventions*. Each of them separately had such amazing value, that either alone would have been sufficient to stamp him as the greatest of benefactors to his country and to the whole world. But he doubled this merit, and as grammarians tell us that two negatives in the English language make a positive, we may conclude that, under some similar rule in the English grammar of invention, two positives make a negative, entitling to a reward *minus* and not *plus*, for he was deemed worthy of no recompense but to be shamefully plundered in this life by the treasurer, the paymaster, and the deputy-paymaster of the British navy, which he had signally served, and after his death to have his reputation stolen, and his children robbed by a legislative committee, bound in secret conclave to cloak and keep, if possible in oblivion, at any cost, those official "high crimes and misdemeanours" which had barely escaped their due and imminent punishment six years before. These three great practical inventions, the steam engine, the puddling furnace, and the grooved roller, marching hand in hand, had, by the year 1790, not only rendered us independent of Russia and Sweden for the anchors to our fleets, but had reversed our import to an export trade in iron, when the last link of good fortune was added to that extraordinary chain of natural advantages and native gifts which had combined to the formation of our iron manufacture. The great continental war broke out, and whilst its continued devastations swept the arts of peace from any abiding place over the face of Europe, our country enjoyed, for nearly thirty years, her self-created monopoly of the steam engine, puddling furnace, and grooved roller, to manipulate the produce of her mineral fields, with all her native force of men and capital.

Our iron trade, founded on these great inventions, was planted and firmly rooted before the war began; during the contest it developed itself without a rival; and cheap bar iron streaming from the roller, developed that unrivalled host of manufacturing machines which fed our commerce, and, in union with their parent, the cheap iron trade, provided the sinews of the war. Those old enough can well remember the floods of foreign inquirers and engineers who poured into this country, after the peace, to visit our ironworks, to investigate the causes of that astonishing position in which Henry Cort had placed us, and to transplant our processes. We can likewise recollect the *wise* penalties levied on the exportation of machinery. The steam-engine, the puddling furnace, and the grooved roller have, nevertheless, in spite of them, been now established over both the old and the new worlds; and the question agitated is, are other nations applying them more successfully to *their* mineral resources than we have done to ours, so as to compensate for that greatest of obstacles to competition, an extended inland communication? The excellent system of foreign railways, we are told, will mend this drag, to our disadvantage; it is true they manage these things with a centralising energy of which we know nothing, for all our efforts are individual and antagonistic; but will they ever make 100 miles in one territory equal to 50 in another? Is it likely we shall be beaten by our own weapons, and have the plumes struck from our iron crest by an arrow from our own quiver? We originated not only the railway, but the *means of making rails;* for it is by the grooved roller only that foreigners or ourselves do, or can, profitably produce them. This was the offspring of our native practical acumen, and can we doubt that, whatever demand may arise, we shall again find shoulders equal to the burden. It is by thus considering the subject in its great outlines, and taking the broad facts of difference between ourselves and others, that we can alone attain materials for a comparison. A microscopic examination of a few drops of water taken from two rivers, can afford no light upon the direction of the streams they are taken from, their comparative volume, sources, tributaries, and navigable length, not even if the drops from one should be a little brighter than the drops from the other. Foreigners have a subtle and studious tact, very capable of refining and improving on the substantive material of the inventions they adopt; and it is, therefore, the more to be regretted that this paper furnishes no definite details for judging what thay may have lately done in that way in the iron manufacture. But let it be ever so much, it will not do to forget that we *created the original staple.* We can do justice to others without doing injustice to ourselves. Consider the force, the facility, and the comprehensiveness, of the three great practical solid inventions which I have shown are the basis of the iron trade; the plain master grasp with which nature has been seized, and her simple principles forced to conquer her own most weighty difficulties, when the proper moment arrived for attacking in earnest our great mineral treasures, and I think few will doubt the continuance of our superiority if we continue honest. Should other great solid practical inventions be demanded by emergent occasion, is it likely we shall be unequal to the demand? Our fertile and forcible native soil, which has furnished such a crop of them, will be ready again for the sturdy birth; though not highly comminuted for the growth of flowers, whenever the dragon's-tooth of necessity is cast into it, inventions, fully armed, will spring up of which now no one dreams.

In the foregoing enumeration of the broad facts of our position and our advantages, the *quality* of our labour is a very important item, against which, so long as it continues, there can be no effectual competing. Labour is the main element in the cost of iron; a man who, in a large establishment, can do double work, is worth four times the wages, so that wages nominally high may be actually low. Foreigners may be most assiduous in ingenious contrivances for lightening physical duty, but, when the utmost is done, there will remain a necessity in heavy manufactures for solid enduring physical capacity, which, when satisfied, will turn the balance. Of the comparative quality of American labour I have no knowledge; but if it equals ours, its higher price, in conjunction with the inland distance of their main mineral deposits, is likely to deprive us, for a long time, of serious rivalry in that quarter. The only great eventual danger is the exhaustion of our stores, and the increased price of materials, as that term approaches. We have gone furthest in that direction; the first and the fastest *in* the race, we may easily be the first *out of it*. But we cannot eat our cake and have our cake. Those, therefore, who are dreading the advance of foreign competition, should rather rejoice at the increase of foreign make, were it many times greater, as a means of promoting the permanence of our home manufacture, that we may go on softly, and not be sucked rapidly to death in assisting foreign nations to reserve their supply until ours is gone. This may be styled the telescopic, in contradistinction to the microscopic, view of the matter.

I have noticed the deficiency in Mr. Blackwell's paper of any precise description of any of those foreign processes, *maziage*, &c., which he thinks we might successfully copy, and the advantages which would have accrued from giving some comparative character to a description *pur et simple* of our own boiling and puddling operations. I would, therefore, make some little reference to a modification of these processes, actually in use in this country, and not indicated, though it realises the means of obtaining, *if the market called for it*, the very object of the paper, a superior quality of iron at a cheap rate. Its history is illustrative of the difficulty of instituting supererogatory works of improvement, and doing better than is ruled to be necessary by the market demand, even though at no greater cost. The process is one of a long series of experiments for avoiding waste and improving the economy and quality of the iron manufacture, to which my late father perseveringly devoted all the spare time of an active life, and I shall presently refer to another of his means for supplying these desiderata. Rather more than twenty years since, he patented the puddling of pig iron with the pure oxide of hæmatitic and other rich ores. The iron parting with its carbon to unite with the oxygen of the ore, perfectly reduced grey pig iron can be puddled with as much facility, and as little waste, as finer's metal, and the yield is increased by the metallization of the contents of the ore. This method, I conceive, suggested the boiling process, which has the particular economy of working up the waste slags of the forge, instead of resorting to the purchase of new ore. But, as these slags contain all the fusible impurities previously ejected from the metal, this modification produces an inferior iron to the other. When my father's patent was brought into use, it was found that if carelessly worked, without sufficient attention to the small size of the hæmatite, a tendency to red short was developed, the general characteristic of rich ores. My father, having always, I presume, before his eyes a just terror of the rewards bestowed in this country upon inventors who *risk* anything for the public good, made no outlay in carrying on the process, but left it to the adoption of those who might be disposed to the trouble of teaching these men to use it rightly, and keeping them up to the requirements for avoiding red short, and it was but partially introduced. The Staffordshire puddlers well appreciated the increased yield, and gave their masters some trouble in keeping the red ore out of their way. At length Mr. Anthony Hill, of Plymouth works, who has been distinguished for half a century by that *con amore* spirit of improvement in which Mr. Blackwell considers the foreign manufacturers so much exceed us, took up the matter in earnest, and, by taking that intelligent pains which no one else cared to take, introducing proper fluxes, and slightly altering the shape of the furnaces, he brought his operations to the highest economical and qualitative perfection. When I was last at his bar works, the whole puddling furnaces were working on red ore and *cold blast* pig to the greatest advantage. Yet, with the results before them plainly realised, and needing nothing but adoption, his neighbours did not care to encounter the trouble of working workmen into new refinements for making, cheaply, iron of a better quality than the market insisted on. Indeed, as I have referred to the quality of British labour, it may be worth while to notice another characteristic, which is, no doubt, one development of its solid sullen energy, alike displayed under the fire of the field or of the furnace. "The most lazy diligent people under the sun," as old De Foe termed us, we exhibit an equal immoveability either in the camp or the workshop to the exercise of small dexterities and niceties. The British workman makes massive and effective efforts; he grumbles at his objects and overcomes them well. Those lighter qualities, which captivate so many of our travellers abroad, and send them home doleful and despairing over English infirmity, to see a degradation approaching only to be re-animated by an assiduous import and imitation of everything foreign, without a thought whether it suit our habits or possibilities, impart the peculiar characteristic to foreign manufacture. There the workman throws something of the feeling of the *artiste* even into hard labour; he toils *con amore*, and *likes* certain delicacies, which our rough race set their foot on with disdain. This opposes a peculiar difficulty to introducing the *beau ideal* of *quality* into our ironworks out of pure enthusiasm. We can only, as a general rule, adopt such novelty as is certain to be worth the inevitable *rise of wages* on the heels of *rising value*. The Englishman always looks strongly to the *main chance*; "strike" is a very English word; those experienced in the different *manageability* of different nations, will give their testimony that it is less easy to idealise our iron manufacture *in situ* than in the Adelphi.

But Mr. Anderson raised a very important question. As a consequence of the above peculiarities, the natural character of our practical men is averse to a parade of science—to anything like fuss and fiddle-faddle; men who have a great deal of real business to get through, and must get through it by efforts of strong judgment and wholesale decision, have also little time for a wholesale organisation of accessories such as Mr. Anderson described. We may, perhaps, go too far in this aversion, and leave many valuable details unattended to. I admit that the great ironmasters who have mountains of ironmaking materials at command, to pour forth unlimited quantities of gold-making iron, participate to the full in that occupation, the same "lazy diligence," characteristic of the workman in his employment. They are doing what they want to do on a great scale, loaded with weighty concerns and sturdy workmen, and are generally disposed to look on scientific men and their appliances as a sort of small deer they cannot be troubled with. This is no imputation; our first men in the trade frankly admit the prepossession. It partly arises in the *physique* of their minds, naturally enjoying the same rude health as the native workmen's energies, strong in massive purposes,—and partly in the very character of their works, which are not those omnigatherums so correctly described by Mr. Bird, doing a little of everything under the sun. But I fear there is yet another reason in this country for the comparative repulse of scientific aid from the precincts of our great manufactures, namely, the *quality* of that science. The science of the most practical country in the world is, perhaps, the least practical of any. I should hardly venture on this unpopular assertion, though my conviction of its truth is long and deep-rooted, had not the Chairman of Council [Dr. Booth], in the luminous address which opened the present session, advanced these very opinions, and apologised for their "unfashionable" character. There is a sort of metamorphic form of science in this country very peculiar to ourselves—*i.e.*, *science for amusement*. It was in some such spirit that we were told, in 1851, by one of the eight great theologians, that in the most instructive and entertaining lounge of the Great Exhibition was at length discovered that royal road to learning which Ptolemy in vain inquired for. I conceive that nowhere else but in this country is there any considerable number of persons who are able to derive their subsistence by lecturing or talking at large upon essentially practical questions to indiscriminate auditories, who experience no other use in the discourse than to go away and talk of them again. This system, resulting in a general diffusion, or rather confusion, of terms and vague views, something in fact less than smattering, has a doubly deteriorating tendency; it impairs the mind, not of the listener only, but of the lecturer, imparting a superficial *ad captandum* character, rather than a practical efficiency, to the understandings of professors. Doubtless, these conditions find their cause in the effloresence of native advantages. The superfluity of individual wealth, the great amount of isolated independence, the every-man-for-himself character of our polity, are national features. Our intellects are more solid than frolicsome; and the omnipresent idea of utility which pervades the general public leads individuals to persuade themselves that they become of great use by paying to hear a talk about things useful; and a commercial people being always on the watch to turn everything to account, science, or what is called so, is, *inter alia*, seized upon, and converted into a staple of public trade quite peculiar to ourselves. There is a different management abroad, arising in a different set of causes. The superior wealth and energy is concentrated in their governments; individuals are comparatively nothing. There the great market for talent of the highest order is in the service of the state, and, in consequence, all instruction is systematised for definite ends of state. This is well-known, its effects are seen, and ever and anon some one or other of our own independent energizers, in science, politics, or whatever it may be, sets about to gain distinction on his own hook, by importing some plan to re-model our institutions, in shallow oversight of the fundamental causes of difference. Do we not remember how one of these distinction-seeking coteries, our indigenous growth, each laying claim to the absorption within itself of all light and truth, illuminated themselves and tormented others with the grand discovery of a system of education in Prussia, a measure quite as much of police as of instruction; we were to be regenerated at once by its forcible importations, pains, penalties, and all save military discipline. Not a whit less absurd would it have been to enact, under penalties, that Englishmen should speak German, or have a negro's skin. Great facts cannot be altered by incrusting them with narrow-minded imitations. It is not that our government is weaker than the people, but our people that are stronger than the government. The first scientific men in foreign countries being absorbed in purposes of the state, the same definite centralising impulse pervades their manufactures. *Teaching* anything is there always preparatory to *doing* something, not vague and aimless merely to *diffuse* "general knowledge," as it is termed, a general quite as incompetent and incapable as any who have been grumbled at in the Crimea. Their schools really are schools, and if the fact of the same practical system being found by Mr. Anderson in the American democracy, appears a contradiction; it is not so, because they have no superfluity of rich idle people to listen to idealizing lectures. They *must* have a practical object for their time. It is therefore to this "science for amusement" that I think we must attribute a great part of that separation of science and practice so much complained of in our country. The professor gains his emolument by what he calls general ideas; when brought to contact with practical action, being unprepared, he is at fault; he makes some upside down application of his general knowledge, which at once disgusts the practical man, and *science* is condemned. Some men troubled with ambition, and a great sense of their own talents, think they have learned everything when they have heard a lecture, and, setting up as lecturers or practitioners on their own account, increase the gap, and, like inspired prophets, rebuke the practical man who will not hear their schemes, and intrust their interests to burlesque speculations. Such vague untested teaching and learning is undoubtedly a great misfortune, though it may be very difficult to find a cure. The popularity, and therefore the profit of these disquisitions is always proportioned to the comprehensiveness of the subject, the discursiveness of the treatment, and its remoteness from practical application. Yet nothing can be learned without deeds as well as words. Whoever made money by general lectures on the four rules of arithmetic, or on the copy-book? We stick to the practical, and give a boy a slate and a pen, not a pair of ears, of any dimensions. What hurts the mind more in any of its divisions than to theorize and not to do? Another of our great commercial pursuits comes in to fan the mischief of science for amusement—viz., the bookselling trade. If a lecturing author has some little fancy, fluent style, and literary tact, so as to make a nice assortment of notions, travels and quotations interspersed with anecdote, twined about a small nucleus of fact, such a composition may become a standard work of science for the drawing-room table, having as much resemblance to philosophy as an historical novel resembles history. Some of our sciences are by this process so thoroughly popularized, that truth is disagreeable, and common sense put down upon the authority of mere literary dreamers. From the peculiar social conditions already referred to, this kind of visionary talent which working men will have nothing to do with, too often finds its way to government patronage, and aggravates the barriers to a true union of science and practice. A man of sound ability in this country can do much more for himself than the government can do for him, hence the public takes the useful men—the state, the pedants and plausible men. This inevitable consequence of our social features, has its misfortunes; it has rendered our government efforts at scientific progress such remarkable failures; they merely provide for that calibre which finds no good market in the general intelligence and wants of a practical nature, and do infinite harm by disseminating, under a certain warrant, theories which are sometimes actually false, and always delusive when not correctly enforced upon the understanding by practice. People are beginning to see that trade in teaching ought to be as much a free trade as any other, and that no good arises by encouraging the weak under bounties upon forced production. Theory and speculation are natural efforts of the human mind, but let them flourish indigenously, not under the seal of authority and at the cost of truth. The talking and reading mania, *de omnibus rebus et quibusdam aliis* has by no means improved our universities. It is better, as has been well said, to know everything of a little, than a little of everything. A mind so instructed knows the greatest of all knowledge, its own ignorance. What can be learned, for instance, by listening to lectures in a collegiate town, upon some unsettled, uncertain arena of speculation, such as geology or political economy. Time and intellect are dissipated in getting up, or rather down, to the general level of talk at random, where nothing is begun and nothing ended. It would prove as practically useful to teach mining and farming in London from a collection of stones and some pots of Dickens's gloomy geraniums. The sciolism of such intellectual dissipation is telling every year more and more in the skirmishing shallow ideas of public men. None would rejoice more than myself to witness such a union of science and practice prevailing in this country as Mr. Anderson describes, and flourishing under our transcendental philosophy of money-making. But this state of things cannot be *forced*, it must spring out of our necessities; it will be only hindered by a further supply of public pedantry. The movement, with us, must come from individuals, and all its requirements will be met when there is real necessity and real danger of receding for want of them. I do not deny there is a large field lying waste and uncultivated, but there seems to be a beginning. The Cwm Celyn Company, for instance, have attached an acute and qualified chemist to their establishment, and I believe they do not regret it.* I only wish heartily that our scientific men had more such opportunities afforded them of completing their mental edifices by the coping stone of practice, without which the substructure is labored in vain. They can no otherwise acquire that apprehensive grasp of *main points*, bearing the test of utility, which is so eminently required to save the subdividing scientific intellect from being bewildered in the microsopic detail of closet researches. It is in this more constant opportunity for the union of thought and action that the foreigners have advantage over us. But light is breaking on many sides, and the necessity of a practical finish to a theoretical education becoming acknowledged. Even the great dream is growing troubled, and people are waking to discover what wiser heads long since told them, that restraining the children of the poor all their most docile years from the proper industry in *common things* of daily life, and keeping them amused with eccentricities, which, however interesting, have no bearing on their station or their daily bread, creates only worthless and wretched members of society. *Reforming* them has begun, and may perhaps lead us back to the more rational feature of *prevention.* I trust Mr. Layard's clear views, in his address to the University of Glasgow, may prove *contagious.* With due respect to both houses of legislature, I have not seen so much common sense on this subject from any of their members for many years. Except Cobbett and Colonel Sibthorp, no one has been bold enough to even venture in that direction, and they unfortunately were always laughed at.

I feel at a loss to understand what bearing upon the comparative question it is intended we should give to the lengthy description of the ideal of a blast furnace, because the form described is one of those comprehensive efficacious changes *made by a British practical man* which are eminently our characteristic, thus adding another item to the comparative inference in our favour, and according to the latest sections of foreign blast furnaces which I have seen, this vast improvement has not yet been much adopted by our neighbours. Here again a good large section on the wall would have been a great saving of time, conveying at a glance, for observation and reflection, the fact which has to be travelled after through pages of a delineation in words. By the contrast with a few sections of the furnaces of our foreign rivals, we should have had light at once condensed from twilight. I perceive through the whole of his paper Mr. Blackwell is rather careful to exclude the mention of authorities. He may have obtained the whole extent of geographical and geological details in the various countries by personal unassisted labour, and the protracted reasonings on the blast furnace may be likewise entirely his own, but I doubt if the importance of a man's own labours is at all diminished by reference to confirmatory though no doubt inferior authorities. I like better Mr. Scrivenor's treatment of these subjects; it is more luminous and satisfactory to ordinary minds. The change in the shape of the blast furnace, for instance, is interestingly and candidly referred to its proper author in the last edition of Mr. Scrivenor's most valuable work. The alteration from the old narrow high hearth, the flat bosh, and contracted conical upper chamber, is an event so illustrative in all its particulars, that I confess in listening to an abstract idealized version of the result I felt (to compare great things with small) as if there were before me a history of the change of government in France from a wild democracy to the most illustrious despotism on record, in which the name of Napoleon was entirely omitted, and abstracting time, place, and circumstance, general rules were excogitated to reason us into the knowledge of what a good despotism ought or ought not to be. A matter so important to our iron manufacture as the change of the blast furnace, should never be named without the name of its author, Mr. John Gibbons. Different minds take different views, but I am myself never at ease in any explanation unless I give the merit where it is due, dreading any appearance of the appropriation of what is not my own. Nor, as I before remarked, do I think this exercise of candour diminishes anything from a writer's all-sufficient appearance. It can be no derogation to follow the example of the record which informs all time that "Tubal Cain was the instructor of all artificers in brass and iron." I admit it needed a powerful intellectual effort to give this abstraction of a blast furnace, but it has the disadvantage of abstracting also some of the chief practical principles which guided the inventor in his discovery, and making prominent some minute considerations which appear to have more weight on Mr. Blackwell's convictions than they have on mine. But as these have no reference to the comparative trade of different countries, it would be out of place to state my differences, and I will refer to only one of them. I think if Mr. Blackwell will study for three minutes the action of a common sandglass while his egg is boiling, he will not remain of opinion that the materials in the blast furnace descend in the symmetrical idealism of parallel straight lines. I should like to have heard whether any explanation has yet been arrived at of the cause of the extra wear of the sides of the blast furnace above the glazed zone which occurs under the use of heated air, and whether this feature is equally developed in the foreign hot air furnaces.

The mention of Mr. John Gibbons's name, as the author of a comprehensive revolutionising improvement in the efficacy of the blast furnace, would have been the more properly interesting, because his brother, Mr. Benjamin Gibbons, by taking the like grasp of simple principles of nature, which it is the singular deficiency of the inferior mind, simple as they are, always to overlook, has been the great reformer of colliery ventilation in Staffordshire. His improvements established for fifty years in his own works, have more or less perfectly been adopted throughout the country, and but for the vested interests of costly collieries, commenced upon imperfect plans, and which have found in the Davy lamp the great "protection" of their indigenous deficiencies, the loss of life from explosions in all other counties, would ere this, have reached a minimum, which has not been reached, and never will, by the aid of government inspectors. This foreign importation of power without powers is like all our similar attempts, a dead letter. It is beneficial to the inspectors, but, in the absence of all proper force, unbeneficial to the safety of the collier. We ought first to make the crown the universal lessor, as abroad, and this, I think, we are not likely to do; and then, how are we to compass the other desideratum I have referred to, of bringing, according to the foreign fashion, the *first men* into state harness. The mines which the crown does possess in this country are looked after no how. Strings of red tape, proceeding from the metropolis to the country, are poor sinews of management twitched and cut at all turns by *parliamentary* interest. The best officers on the spot are rendered helpless by such a system. At this very moment this mythic power is doing its best to let a large sum of public money slip into private hands, with the addition of inflicting on other private men not so favoured a penalty of some £80,000, with the grossest injustice. If this grievance is redressed, (and by the bye the Ebbw Vale Company have to bear the heaviest share of the burden), it will be owing not to the proper efforts of public officers whose duty it is, but to the public spirit of private men, whose duty it is not, who guard their private interests at a great disadvantage. In fact, the habitual treatment of valuable inventions (the *original* Minié rifle ball, for instance) shows the total incompetency of our official mind.

As Mr. Blackwell has gone so far into the chemistry of the blast furnace as to state the now generally recognised fact, that deoxidation and decarbonisation are effected by the gaseous oxide of carbon, and not by the solid fuel, as was held for many years even after the discovery of a gas so different in its properties to carbonic acid, I think that in a paper read to a general society, some reference ought to have been made to the writers, home and foreign, who first promulgated a theory which has such a new and important bearing on all the processes of the iron manufacture.

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* See, in point, Mr. Scrivenor's letter in the *Journal* of 25th January.

It will be interesting to Mr. Blackwell to be informed that the improvement he has suggested, for permitting the employment of the best qualities of perfectly reduced pig iron, without undue waste, in manufacturing bar iron by re-melting the grey pig in a cupola furnace with pure ores of iron, has long since been perfectly carried out in this country. This process formed one of very numerous endeavours of my late father's indefatigable and philosophical mind to improve at once both the quality and the economy of our iron manufacture. He patented the process about the year 1817, and carried it into successful and profitable operation both in Wales and in Staffordshire. But there are always great obstacles to superseding old established operations by anything new, unless there be a commanding commercial necessity to *compel* the change. The old refinery which this process was intended to supersede, was in extensive use; it did well enough for the requirements of the market, and the advantages of the novelty were not of the overwhelming character which can alone induce the trade to encounter the dilemma of re-instructing their workmen.

Such examples are very instructive. They exhibit the difficulties which practical men of the largest capacity, energetic activity, experience, and copious information, have contended with in attempting that improvement recommended in this paper, and how much easier it is for those whose vein of humour lies in that direction to deprecate British stupidity and laud foreign intelligence than to establish the fact.

It would have been important to have had some particulars given of the cases where the wasteful expenditure of pig iron now amounts to 30 cwt. for a ton of puddled bars, so as to judge whether, as implied, this is actually "a sign of the times," or the mere error of insufficient or incompetent ironmakers. The impression conveyed is, that the whole iron trade is retrograding from the former waste of 25 to 27 cwt. per ton of bars to 30 cwt., a fact, if true, so important as to demand no slight or ambiguous handling, but a searching investigation into causes and remedies. Such an extra waste amounts upon our yearly make to half-a-million tons of iron per annum destroyed. Mr. Anderson says that forty years since we made better iron, and certain it is that nearly seventy years since, in the very infancy of the puddling process, we had no worse yield. In 1789 the puddling furnaces and rollers erected under Mr. Cort's patents at Pennydarran, were brought into operation; and I have an extract from the books of that firm, dated March 11th, in the writing of Sir Jeremiah Homfray, who was shortly after supplanted in the management of the works by his brother Samuel, who deceived (?) the House of Commons in 1812, giving the result of the first experiments:—

"Feb. 21st, 1789.

"Pigs delivered—Patent furnace, 3 tons 13 cwt. 3 qrs. 7 lbs. Produced: blooms, 2 tons, 8 cwt. 1 qr. 29 lbs.; bars, 2 tons 1 cwt. 1 qr. 20 lbs.

"Takes 1 ton 10 cwt. 1 qr. 23 lbs. pigs to make 20 cwt.: blooms, 1 ton 15 cwt. 2 qrs. 17 lbs. pigs to 20 cwt. bars.

"Chaffery takes 1 ton 3 cwt. 1 qr. 19 lbs. blooms to make 20 cwt. bars.

"Coals used in the furnace, 6 tons 12 cwt."

This was the first trial at the new furnaces. Sir Jeremiah states that the masterman was nearly incapacitated by an accident to his hand, and expresses a certain confidence, when the men are practised, and in proper trim, that 30 cwt. of pigs will be ample for a ton of bars. Further details of progress were cut off by the accession (under circumstances notorious in the county), of a manager determined to defraud Mr. Cort. But as the result is from puddling raw pig, before its preparation in the old refinery was thought of, and as the bars were *hammered*, the rolls not being at that date completed, it is a startling assertion, as a picture of the present position of the iron manufacture, that 30 cwt., after 70 years' experience, is becoming the mark for a ton of bars, refinery, iron bottoms, squeezers, boiling, &c., &c., inclusive. The loss in the chaffery is enough to show that the mere manual skill was in quite an elementary condition.

The *direction* in which we are likely to successfully seek for any abbreviatory improvements in the ironmaking details, is the great question suggested, on which I would offer some hints derived from a long intimate acquaintance with an extent of experiment directed to that very end, of which Mr. Blackwell, I think, has not had the means of forming any conception. The field of success is much more likely to be found in, or in connection with, the puddling furnace, than in any of the processes preceding it. My father's own views, after prolonged experiment, were in favour of that conclusion. Whether the reverberatory furnace is ever to become the sole agent of manufacture for working bar iron, metallized by the direct process of cementation, without fusion, is for the future to prove, and it is not likely to be proved, until the easily reduced earthy ores approach exhaustion. Cast iron is an essential in commerce to an almost equal degree with bar iron; and so long as the blast furnace exists for its production, a part of that produce will continue to be applied to the preparation of bar iron, the blast furnaces thus standing as a barrier to the comprehensive introduction of any system independent of it. But it is not likely that anything of the nature of a second blast furnace will be adopted for treating the pig iron before it reaches the puddling furnace. In so weighty a manufacture, all details of any thing like amateur complication must be as much as possible removed. When the markets of the world and the conditions of supply demand some change in the processes of production, this demand (if ever it arises) is most likely to be satisfied by modifications of the puddling furnace; probably by combining the use of pig iron with the use of rich ores, either raw or cemented, or both, and proper fluxes. Much has been done in this direction, and more may be done when required. The right invention at the right time is but another variety of the "right man in the right place." Circumstances, much more than intrinsic philosophy or ingenuity, command the success of inventors, and nothing more distinguishes the great capacity than inventing, not exquisite refinements, but the great fact which is in instant demand. Watt stept into a wide field waiting for cultivation, and Cort did the same. Steam engines and rollers, in one shape or other, had long been known, but the period had not arrived for their full development. Watt's improvements furnished the means for perfecting the locomotive which now sweeps along thousands of miles of rails stretched out by the agency, essential to their existence, of the grooved roller. It is vain to waste time and labour on inventions not suited to the age; it is for the great and enlightened mind to perceive and work at what the time requires, or is about to require. Existing processes are great facts; to remove them, or to materially modify them, under romantic aspirations after excellence, though such sentiments are the salt of social existence, and their cultivation most laudable, is a very weighty matter. Even when the most animating advantages exist in a novelty, when it is ready to fulfil every urgently desired condition of public service, qualitative, commercial, and economical, its adoption is almost hopeless, should the market be already copiously supplied with a certain degree of an inferior and even dearer article.

Vested interests, plant, skill of workmen, every particular which would be depreciated by a more perfect manufacture, combine to prevent the public from being better supplied. From these combined causes there are inventions languishing at this moment out of public use, which are capable of adding more than another 40 millions to the yearly savings which Mr. R. Stephenson has lately told us are due to railway transit.

And it may be well here to remark on the call made during the evening, and subsequently upon inventors, to devote themselves to furnishing great improvements,—men whom Mr. Bridges Adams, in his letter, rightly designates as the manufacturers' greatest friends. Nothing can be more truly unfortunate than the position in this country of such manufacturers' friends. What with the equivocations of our Patent Laws, and the desperate struggle commonly made by the money-making men to make these gold-producing improvements their own at no figure, or at the lowest figure to the authors, their position as the pioneers of progress is a national stigma. Here indeed is a ready and practical field for qualitative amendment, which I wish Mr. Blackwell had indicated; for, in fact, all his other proposals must remain inefficient while neutralised by this vast grievance. A comprehensive better spirit would carry with it, like a flood, all the accessary details. Friends, if they are, this class of men is treated by the money-makers as their greatest foes. I would readily concede to Mr. Bird and his party that it matters little how much the ironmaster devotes himself to servile gold-finding, rather than to attaining iron of a quality which will find no market, providing the thirst for wealth did not impair the moral quality, and lead him to treat men merely as if they were materials. How far intense and mere commercial habits tend to relax the morality of nations, we may learn from older authorities than Montesquieu. Watt was not beatified as a martyr and a victim, neither was Neilson, but the best attempts were made to confer that fate "more honoured in the breach than in the observance." So certain is it that an inventor in this country will be forced to sacrifice his peace, his interests, and his life upon the public altar of Hermes, that one almost might suppose that those he benefits were mindful of a Druidical origin, and accordingly cemented the foundation of any great edifice of public prosperity with the blood of a human victim. Here, indeed, there is scope for improvement; we truly might do something by levelling this bad eminence which distinguishes us from foreign nations. Anything like the disastrous catalogue which this country can furnish of the treatment of her brightest and most useful children, cannot be matched, or at all approximated, under any foreign government. To devise and carry out in our commonwealth any noble improvements, is pretty sure to be as clear an act of self-immolation as the plunge of Quintus Curtius. He, on that occasion, was no doubt the right man in the right place, but if it be the right place for the inventor, it is but too poor an encouragement for many to aspire after, and beyond doubt deprives the state of many efforts of improvement. The most sound and experienced men do not choose that honour, and exert their energies in exploits of less danger. It is not only the improvement of our patent laws, making them what they ought to be, simply a safe protection for the property of thought which is required, but the establishment of a better spirit amongst the money-grinders, before the call to find them more means to make more money will be responded to as it might be. The treatment of Cort, now attracting so much attention, is only an instance. Certainly it is the greatest in the magnitude of its commercial features, and I only wish it were the worst in its moral and legal details. I doubt if we shall attain to that point of Sir David Brewster's late admirable remarks, which proposes a bounty for inventors, but we surely might *protect* them, and feel a real *disposition* to protect them, and be thankful for their gifts, securing to them what is their own, instead of levying a penalty upon a man because he happens to have more valuable thoughts than his neighbour. If a fund is to be established for the encouragement of useful inventions, and to aid in protecting them, the foundation would be best laid by some swollen capitalist who has aggregated his two or three millions at the cost of the life and rights of some public benefactor, setting apart the ill-got gains, if not in life, (for the priests of these sacrificial rites have a strong sense of *meum* which seems doubled by absence of the sense of *tuum*) at least after death (which they cannot avoid) to endow a protective and examinative institution which might help a man to his rights, without entering the field of legal quibbles, where the plainest rights are often ridiculously sacrificed to the turn of an empty expression. A discrimination of duties so maintained would tend above all things to preserve the dignity of the judicial functions in respect, for very often, out of mere ignorance, our judges in patent cases so confound the distinctions of right and wrong as to earn the reputation of being the most reckless or hard-hearted of men. They may sit in conscious integrity over the ruin they have made, but the inventing public are equally conscious of a terror of them, and therefore only the very sanguine and eager, and as a consequence the least qualified, are rash enough to venture to devote themselves to this kind of public service. In truth, upon mere commercial principle, I do not understand how those who think iron, steel, tin-plates, &c., &c., are worth notice, and accordingly deal in them, should have no place in their price current for those who show the way to more extensive dealings. These are the very men one would expect to set a value upon an improver as an excellent article. To those who rejoice in an Arcadian or pre-Arcadian simplicity of manners I could conceive an inventor to be an inimical being. The man who toasts, *par preference*, his cake on a forked stick torn out of the thicket, in default of a cutting instrument, who sucks his own goats, or has only a pumpkin rind to milk them into, and in the absence of saucepans or oven ranges, stews or bakes his dinner in a hole in the ground, filled with hot stones, might well repel the intrusion of vendors of hardware, and hang them up on the next tree, but I am at a loss how these latter come to treat what Mr. Bridges Adams thinks are their best friends as their bitterest enemies. In these days of busy exhibition and exposition, when every one is sounding the glories, and making the most they can by hook or by crook, of the toils of inventive merit, it is more difficult to account for torpid neglect or active antipathy towards those who furnish the *Othellos* with all their occupation.

It seems rather a misapprehension to state that the term "boiling" is used in contradistinction to puddling. Some cinder is introduced into the puddling furnace, and the pig iron parting with its carbon causes an ebullition in the fused slag, after which the iron is puddled as usual. Boiling is a variation of puddling of such fractional amount that it can in no way be contradistinguished from it.

I agree that, generally, a great cause of the impression that hot-blast gives an inferior quality of iron to cold-blast, arises in the greater reductive powers of the former, which enables the ironmaster to take liberties with his furnace, impracticable under the old regimen; but there are more definite and useful rules than this for the guidance of public judgment. It is a general feature (of course not without exceptions) that the more fusible an iron the weaker is its body, and as its fusibility is also generally in the ratio of the temperature of smelting, we have a direct reason why hot-blast irons, all other things alike, should be weaker than cold-blast irons. The first great step of increase in the temperature of the blast furnace was the transition from smelting with charcoal to smelting with pit-coal coke, and the result was a pig iron so much more fusible than had previously been obtained, that cast iron assumed a new feature in the arts of this country. See in confirmation, Scrivenor, page

16, quoting the *novelty* of pit-coal iron for cannon, "so soft as to bear turning like wrought iron." Experienced founders are well acquainted with the more refractory character of charcoal pig-iron. The next great step of increase in the temperature of the blast furnace was the transition to hot blast, under which the Scotch iron, always fusible, has become much more so with an attendant weakness of body. There are distinctive differences in the quality and properties of hot blast and cold-blast iron, which ought not to be lost sight of or confounded, quite irrespective of that degree of imperfect reduction which the superior power of hot-air enables the smelter to practice. For instance, there is a greater waste in re-melting hot-blast iron, whether for the foundry, or in the refinery. Neither does the suggestion of the increased use of refractory ores clear up the difference; refractory, in its ordinary sense, implies infusible, and it is actually this class of ores that are the most beneficially treated with hot-air. If an ore or ironstone be of a favourable composition, so as to be readily and perfectly reduced by cold blast, heated air will increase the quantity but not the quality of the product. But if the materials be refractory, whether the fuel, as anthracite difficult of combustion from its density, or ores infusible, for instance, from excessive mixture with unalloyed lime, such as the ores of the western side of Dean Forest, or the similar ores of the Welch carboniferous limestone at Pentyrch, both quality and quantity are improved by the use of heated air. There are many other parts of the kingdom where better iron is made, under similar causes, by hot than by cold blast, because, as a general rule, that degree of temperature, and neither less nor more, which is just sufficient to perfectly reduce the materials, makes the best iron. A less temperature seems to leave something undone, and a greater, to do something too much. The general state of the case would, therefore, be more correctly given by attributing the deterioration of quality under hot blast, not to the use of more refractory ores, for these suffer the least under these conditions, but to the greater quantity and mixture of rich ores in proportion to fuel which the heated air permits the ironmaster to use, and of this mixed quantity it is the *least* refractory ores which sink the fastest below the tolerable minimum of quality. That, *as a rule*, cold blast iron is best calculated for the highest qualities of malleable iron, is a fact so well established, that it is not, I presume, intended to controvert it. Yet it is just as unlikely that we shall go back to cold blast practice in search of quality, as revert to the still better antiquation of charcoal smelting. Indeed, the improvements called for in this paper, are evidently intended to be united with the retention of the hot-air system, and therefore it is the more important to look candidly and distinctly at its inward and characteristic effects or defects. The much greater increased produce which it enables us to obtain from the same labour, fuel, and plant, has quite diverted attention from the previous attempts to introduce economical processes between the blast furnace and puddling furnace—in fact it has had a large share in sweeping away the old refinery standing between the two, and I am therefore the more inclined to think if any effectual improvements arise, they will not go further back than the puddling furnace.

I should much like to see a specimen of the carburetted cast iron produced in the *upper part* of the Catalan fire, and quite agree that the coke used in the congeners and subspecies of this furnace, should be free from slate, or what is in domestic science termed "slat." The correct recommendation will be generally acquiesced in; but the absence of sulphur is a fully more valuable and difficult attainment.

I would here remark upon a species of phraseology by no means peculiar to this author, but which I think tends to convey wrong ideas, as a perversion of those chemical terms, intended to express definite chemical compounds, and therefore inapplicable to the description of mere mechanical mixtures and alloys. The terms silicates and sub-silicates, for instance, are much used in this paper, as if they had a definite signification. Chemical union takes effect in definite limited proportions, giving rise to new substances, and new distinct properties; this is the great atomic law of definite equivalents, and the results are as definitely characterised. But alloys seem to be quite a different matter. Sand or silex may be mixed or melted with oxide of iron into a slag in any proportions whatever, from a unit or a fraction of a unit of per centage. Lime and clay may be added in equally indefinite proportions to effect an *ad libitum* variation of the slag, inconsistent with chemical equivalents. It is common to hear glass called a silicate of potash, or blast furnace slags silicates of lime, but how can this correctly be? silex, potash, soda, alumina, lime, and other matters, may be indefinitely melted into a transparent glass; oxide of iron, sand, clay, lime, magnesia, anything or everything capable of fusion, will unite together into a blast furnace slag. These alloys can hardly be called even solutions of the one substance in the other, for there is no evidence of either being absorbed without increase of bulk in the pores of the absorbing component. The nearest approach in these igneous alloys to a solution, seems the union of carbon and iron. Iron may be assumed to *dissolve* carbon from the most minute dose through the various stages of steel, white iron, mottled iron, up to a degree where the iron appears to be saturated, and the carbon "crystallizes out as graphite." And if we apply the pretty general law—that the solvent power of fluids is in proportion to their temperature, we have an explanation of the higher carbonizing capacities of heated blast, its probability being enhanced by the fact that the graphite or *keesh*, is developed in the hearth below the blast, where the heat of the fused metal must be less than in the higher super-saturating region. Under this reduction of temperature, the iron parts with some of its dissolved carbon in *flakes*, which prove its liberation under stratified pressure. But there is no trace of any action in the heterogeneous components of a slag which can exceed, if, indeed, there is anything which can approach, even this vague degree of solution. Lime, indeed, if it exceeds about 40 per cent. of the silica in a transparent glass, will be seen in white, opaque spots, either undissolved, or unfused, or *crystallising out*, like the mottle of pig-iron. But none of these suppositions will even approximate to the definite intention of chemical phraseology, to express the formation of definite compounds from definite amounts of elements, and the use of such terms misleads, by giving an appearance of importance to what has none, and leads to vague and incorrect reasoning. We might equally call brass a zincite of copper, or sovereigns sub-copperites of gold. The hybrid terms of modern chemistry are an intrinsic injury to the simplicity of language, and only permissible where the inconvenience is balanced by the conveyance of an exact idea. Our more profound writers are always seen to make as little parade as possible of scientific phrases, figures, and symbols. Slag is a good word to express a heterogeneous, accidental compound of metallic and earthy fused oxides, and is familiar, and it is short. Not much would be gained in science, and very little in utility, by calling strong paste a flourite, and weak paste a sub-flourite of water.

As a whole we are greatly indebted for this paper, and the pains which the author has bestowed on it. Iron is a hard and heavy subject, requiring no slight effort to handle, and proportionate thanks are deserved by the attempt. Even the deficiencies of the paper have already been of service in prompting others to indicate those parts in the comprehensive outline which require particulars to be filled in. The very defects appear to arise from a too-willing disposition. Had the author done less he might have done more, and given us tangible details of comparison in matters only hinted at. We cannot put our finger on a single detail of foreign practice, so as to be enabled to say this is either better or worse than ours. Indeed so little is his case made out, that though I went to the room fully disposed to agree with Mr. Blackwell's general position, I left with a different impression. In the absence of any close research into foreign processes, or copious exposition of foreign improvements to date, there remained only the unsupported assertion that in general they did better than us and we worse than them. A considerable sensation has been maintained by the public press that great advances had latterly been made abroad, but there is nothing described in this paper but what has been long known, or has been actually imported from this country, and the inevitable conclusion is, that there are no such great novelties when none of them are brought to support a special case. If there had been even an elucidation, *pro* or *con*, of the current assertion that economy of production in France was so successfully cultivated that it was expected productive duties would soon become unnecessary to the native manufacture, we should have had something; but in truth, as everyone has remarked, the title of the paper and the contents do not correspond. I only hope that the commercial comparison which we were led to expect, and which Mr. Blackwell declared himself unqualified to attempt, will be taken up by Mr. Bird (as hinted), or by some other competent person, for it is the feature to which all the details are mere subsidiary accessories. A right title would have been:—"A Description of the Ironmaking Materials of Great Britain and some Foreign Countries: with a Verbal Map of their Geographical and Geological Position; some Abstract Remarks on some of the Ironmaking Processes of this Country; and a Comparison of the Exposition made at Paris by Ourselves and by Foreigners." The comparison is solely limited to the Exposition, and here, I must confess, I thought Mr. Bird upset Mr. Blackwell entirely. I think Mr. Blackwell right in asking, at such a display, to have the series of minerals from which the iron exhibited is produced, and Mr. Bird seemed to have entirely altered his opinion on the importance of that addition, but either the absence or presence of such a collection is a mere matter of packing and carriage, and has no bearing on our respective trades. They are interesting, and not much more. The gigantic rails, which Mr. Blackwell stigmatised as so inconvenient a barrier to the examination of minutiæ, are, to my mind, true exemplifications of the iron manufacture of this country. They illustrated not only the power of our machines, but the physical strength and capacity of our workmen, and were truly national displays. Any child of any country may gather specimens of coal and stone. Nations with limited capital are forced to unite in their works various branches of manufacture, and it was not to be expected they would leave out any of these when exhibiting on their own soil. Mr. Bird appreciated the articles from Eschweiller at their exact value; the real feature distinguishing these works, their economical arrangement, was less capable of being exhibited. Indeed, in that respect, Mr. Blackwell might seize an opportunity to draw a heavy argument against our "lazy diligence" in treading our own beaten paths. Some years since, after these works had been completed and known in this country, a large mill, equal to 1,000 tons of bars weekly, was erected in Wales, and Mr. Blackwell present at the opening, with all the old-fashioned lumbering appliances and heavy driving shafts, wasting the transmission of distant power. Whoever may take up the important task of completing the desiderata which have been called for on this most extensive topic will I trust favour us with a more liberal reference to authorities. It is inconvenient to have so much depending upon the thread of a mere *ipse dixit*. The discrepancy between Mr. Blackwell and Mr. Bird on the priceing of British exhibits, strongly enforces the necessity of such a course to correct those errors to which we are all liable. From his position as Commissioner, there can be no question Mr. Bird had the right story, and there are other statements where I happen to be intimately conversant with facts and localities, which lead me still further to recommend, as a most valuable feature in a discussion of this kind, a free, copious, and unhesitating reference to open and original sources.

Jan. 26, 1856.

P.S.—Errata last week in "Cort's Inventions," p. 181, 17th line from bottom, for *James* read "Samuel;" 5 lines further, for *with* read "into;" next line, for 1754, read "1782;" p. 182, 11th line, for 1798, read "1788;" 25th line, for *Mr. Banks*, read "Mr. Black." I ought also to have discriminated that it was the puddling furnaces *only* at Cyfarthfa, Penydarran and Dowlais, that had been in operation before the extent in aid. The rolling mills took some months more to complete, and then the mandate was issued to destroy "the little mill at Fontley."

Biographical Notice.

ARCHIBALD BUCHANAN,

Of the Catrine Cotton Works, Ayrshire.

The subject of this memoir was the youngest child of James Buchanan, a small landed proprietor of Carston, Stirlingshire. He was born in 1769, his mother being then 50 years old. In 1783, when about 14 years of age, he was seen at the house of his brother, in Glasgow, by the celebrated Sir Richard Arkwright, of Matlock, Derbyshire, and at the particular request of this gentleman, he was sent to him to learn the art of cotton spinning. His mother (at that time a widow) despatched him with a herd of cattle to Sir Richard, for the purpose of defraying any expense to which he might be put on her son's account.

It may not be out of place here to state, that when on a visit to the late Mr. Arkwright (son of Sir Richard) in the summer of 1818, Mr. Buchanan saw an old man working in the garden who had accompanied him as an assistant drover in 1783.

Archibald Buchanan remained for a year at the works of Sir Richard Arkwright, who, during the latter part of this period, confided much to his care, and took him into his own house to reside.

On his return to Scotland (being then under 16 years of age) he took charge of the Deanston Cotton Works, near Doune, Perthshire, the property of his brothers. During his sojourn there he assisted a neighbour, Mr. Fergusen, of Lundie, parish of Kilmadock, to produce a thrashing machine, which must have been about the first of the kind in the country, and as a proof of its excellence, it may be mentioned that this machine was actually in use until about the year 1840.

At the end of the last century, the Ballindallock Cotton Works, Stirlingshire, having been purchased by Messrs. James Finlay and Co., Mr. Buchanan joined them, and took the management. While residing here, he married Miss Ellen Robertson, daughter of the Rev. Louis Robertson, of Dunblane, Perthshire. By this lady, whom he lost in 1807, he had two sons, James and John, who appear to have inherited the mechanical genius of their father, and have, like him, become inventors and patentees.

In 1801, Messrs. James Finlay and Co. became the proprietors of the Catrine Cotton Works, Ayrshire, and Mr. Buchanan removed there as managing and resident partner. He soon afterwards acquired the three small properties of Daldoreh, Over Catrine, and Shaw Mark, on the former of which he built a suitable residence, naming it Catrine Bank.

At the end of the year 1810, Mr. Buchanan was again married. His second wife was Miss Hannah Struthers, a younger sister of Mrs. Kirkman Finlay, the wife of his partner, the latter being at that time Lord Provost of Glasgow, and M.P. for the borough. By this lady, who still survives, he had one son, Archibald, now his father's successor at the Catrine Works, and four daughters, two only of whom survived their father.

Mr. Buchanan became well known not only as a successful spinner, power-loom weaver, and bleacher, but also as a man of high mechanical acquirements, and considerable experimental knowledge in agricultural pursuits. One of his most valuable efforts was the great improvement of coupling, on the same crank shaft, the two engines of 40 horse-power, at the Catrine Works, about the year 1814. So doubtful of the effect of this experiment were engineers generally, that Mr. Cook, of Glasgow, (then one of the first engineers of the day) who fitted up these engines, declined to be responsible for the result.

The idea of combining the two waterfalls at the Catrine Works into one, produced the famous wheels still at work there of 100 horse-power each, 50 feet in diameter, and 12 feet wide. Being in want of proper parties to execute a job of such magnitude, Mr. Buchanan went to Manchester, and at the suggestion of his friend, the late John Kennedy, he employed the then rising firm of Fairbairn and Lillie, of which the now celebrated William Fairbairn, C.E., was a partner.

Mr. Buchanan made some important improvements in the dressing machine for preparing warps for the power-loom. (See White, "On Weaving by Power," page 143, published at Glasgow, 1847.) He obtained patents for two of his inventions. The first, No. 4,854, 16th October, 1823, having, for its object, to produce a variable speed in the vibration of the lay or batten, so that the lay may be as nearly stationary as possible while the shuttle is passing through the shed, and may move with a rapid smart stroke when beating up the weft, thereby permitting the loom to be driven at a greater speed. His second patent, No. 4,875, 4th December, 1823, was for an improvement in carding engines, whereby the top cards were regularly stripped and kept clean without the aid of hand labour. The speed of his looms generally was greatly increased long before those belonging to the rest of the trade. (See Mac Phun's *Glasgow Mechanics' Magazine*, No. 8, 1824, and No. 20, 1825.) His carding engines continue in use at the Catrine Cotton Works and elsewhere, and some are even now in course of construction by one of the first makers in the trade, the self-topping movement being still considered to be the best. At Catrine, the self-acting mule, which was designed and erected by him in 1826, first succeeded satisfactorily.

As a practical farmer, he was one of the first to adopt the system of under-draining, which he applied about the years 1822 and 1823, to the small estate of Daldoreh, making drains twenty inches deep at every twelve feet. His celebrated nephew, the late James Smith, of Deanston, had in early life acquired his farming, no less than his mechanical knowledge and tastes, from his uncle. (See *Journal of Agriculture*, No. 30, New Series, pages 458 and 463, October, 1850, and *Chambers's Edinburgh Journal*, for June 28, 1851, No. 391, New Series, page 408.)

Mr. Buchanan long acted as a Justice of the Peace and Commissioner of Hipply, in the County of Ayr.

In his earlier years, Mr. Buchanan served in the Stirlingshire Yeomanry Cavalry, and, subsequently, in the Ayrshire Local Militia. His father, James Buchanan, of Carston, when with his regiment, the Scotch Greys, in England, for the first time saw lime used on land, and, subsequently, he adopted this process (then unknown, at least in this part of Scotland,) on his paternal property. He was also the first who had a wheeled cart to the north of the River Forth.

Mr. Archibald Buchanan continued to reside at Catrine Bank until his death, which took place in the spring of 1841.

Colonial Correspondence.

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ADELAIDE, SOUTH AUSTRALIA.

The Secretary to the Adelaide Philosophical Society, writing under date of the 18th October last, says that the "Society is at present endeavouring—I hope successfully—to organise, with the assistance of Government, an exploring party, to ascertain the nature of the country in the north-western region of this province, which comprises an area of 150,000 to 200,000 square miles of entirely unexplored territory."

THE NATURAL RESOURCES OF BRITISH HONDURAS.

Belize, British Honduras, Dec. 17th, 1855.

Sir,—The Boreal breezes have set in; the morning air is fresh and cool, the quicksilver in the thermometer ranging from 65° to 72°,—flocks of teal, and duck, and snipe have paid us their hiemalian visit, and may be seen in thousands at daybreak in the various swamps and lagoons with which this country abounds—and bare-legged sportsmen wading up to their middle, with guns at full cock, are stealthily approaching them, with a view of enfilading about a hundred at one shot. Sambo never dreams of shooting his game when it is upon the wing. Such a preposterous idea never enters into his wool-enveloped cranium; he prefers to take them sitting, and never fires until after a deliberate aim of at least a minute. The teal of this country possesses a very fine flavour, and it is usually exceedingly fat. The ducks are much inferior, the flesh being coarser, and the taste rather insipid. There are four different kinds of ducks in Honduras: they are the wild Muscovy duck, the gray-bellied duck, the whistling duck, and the English wild duck. The wild Muscovy duck is a large bird, about the size of a goose; and, excepting a slight tinge of a sort of invisible green upon the back and the curve of the wing, quite black. I have heard it highly spoken of, but it is not good eating,—it is coarse, tough, and tasteless. The whistling duck, in point of flavour and fatness, ranks next to the teal, but by no means comes up to it. Snipe and woodcock are abundant at this season. The former is equal to the English snipe, but the latter is a very inferior bird. This species of game is seldom exposed for sale, for being shy cocks, they are not to be caught sitting, and that is the only posture in which they may consider themselves in danger; as long as they are cleaving the air they may feel assured that they are all right. An exceedingly estimable member of the feathered society may also be found luxuriating in the pools and swamps at this period of the year—it is called the clucking hen. It is a branch of the numerous and respectable family of the cranes, has stilt-like legs, a long bill, and is about the size of a small domestic hen; the skin is thick and leathery, but the flesh is white and delicate. This bird possesses the extraordinary power of producing a note similar to the tinkling or tolling of a distant bell. In passing along the rivers at night, travellers are often startled by this sound, and give way to various conjectures. The story of Ralph the Rover, and the Monks of Aberbrothock, comes to one's mind, and though we don't go so far as to believe that—

> "The devil below is ringing his knell,"

yet that strange tinkling heard at midnight in the depths of the forest, where there is no human habitation, and probably never was since the world began, breaking the stillness of that dark and quiet hour, has a mysterious sound, and is well calculated to produce uneasy thoughts in the minds of the ignorant, and inspire them with a superstitious dread of the tangled recesses of the leafy wild. I have forwarded to you by this packet the preserved skin of one of these birds, also one of the whistling duck, ditto the gray-bellied duck, ditto the English wild duck, ditto the Honduras snipe. I have also sent you a curious fish, of the crustaceous tribe, which is found in these waters. I am unable to give it a "name," though I tell you its "local habitation."

In a former letter I mentioned that a tree, called the Ebo tree, grew on the Mosquito shore, from the nut of which an oil was extracted, which was considered to be extremely nutritious to the hair. I have been fortunate enough to procure a bottle of this oil, which I now forward to your Society. I can, myself, form no opinion whatever of the merits of this extract, but I have little doubt that it is a valuable production. I have never seen the Ebo tree, and I have not the least idea what description of tree it is. I am pretty certain that it has never been found in British Honduras, although it is, I am informed, very plentiful in the Mosquito country. I have sent to you, along with the articles above-mentioned, a considerable quantity of the snake root, and also a bottle of its tincture. The latter will require to be strained before it is used. I was at first led to believe that it was the real guaco, but I am now convinced that it is not. I should much like to know the opinion of medical men in England of this root; that it possesses certain very powerful medicinal properties there can be no doubt—its intense bitterness is a proof of that—but whether it can justly lay claim to the curative virtues which have been ascribed to it, is a fact which requires to be ascertained. In my opinion, it is the duty of the pathologist and the analytical chemist to make strict inquiries into the character of every material, vegetable or mineral, which is believed, rightly or wrongly, to be a remedy for any disease. Accident has given birth to some of our most valuable discoveries, and the effect of every medicine must be ascertained by experiment. A universal practice amongst a people, however ignorant and uncultivated that people may be, of swallowing the juice of a certain plant, or the powder of its bark, as a remedy for a particular disease, must have originated in an accidental cure, or supposed cure, having been effected by it. Its medicinal properties could not have been communicated by revelation, nor could a knowledge of them have been arrived at by any process of reasoning. We do not possess a more valuable medicine than quinine, which in damp and unhealthy climates has saved so many thousands of lives. It was by the purest accident that the medicinal virtues of the Peruvian bark—from which quinine is made—were discovered. A poor sickly Peruvian, one minute shivering with ague, the next scorched by fever, rushed to a pool of water which was in the midst of the forest, to slake his burning thirst. It was the Bethesda of the wilderness. The naked Indian drank greedily of the water, it was bitter to the taste, but it expelled the fever. It was found that some trees, afterwards called Cinchona, from the Countess del Cinchon having been curad of ague by the bark of a similar tree, growing upon the margin of the pool, had fallen into it, and had imparted their medicinal virtues to the water.

There is a plant which grows very commonly in Honduras, an infusion of the root of which is used by the negroes for disorders of the stomach. I am ignorant of its name, but I will endeavour to describe it. It is a low-spreading shrub, having a long slender stalk covered with blunt thorns, at the end of which is a yellow flower, about three inches long. This flower is singularly formed. The upper part of it is compact and waxy-looking, the leaves overlapping each other, and giving it rather the appearance of an acorn. Underneath this there are eight or nine oval buds, the size of the kernel of a filbert. At the bottom of all is a group of half-opened, timid-looking, yellow flowers, a little lighter than the buttercup and a little darker than the primrose. The leaves are somewhat spear-shaped, and a dozen or fourteen grow upon one branch. The pod is from three to four inches long, serrated at the edges, and having a high ridge running down the middle on both sides, and a sharp but flexible thorn at the end. I have sent you two roots of this plant. I wish I could send the plant itself, for in England it would be considered very pretty. I will, however, send some of the seeds as soon as they are ripe.

The ground nut, or pindar, is cultivated here to a considerable extent. I believe that a valuable oil is capable of being made from this nut. I have been informed that large quantities of pindars are exported from the Gambia, and other African settlements, to France, for that purpose. I see no reason why Honduras should not compete with them in this article of trade. The pindar, when roasted, is an agreeable nut to eat.

The cashew tree is very common in Honduras. It bears a fruit like an apple, at the end of which is a nut of the shape and size of a rabbit's kidney. This apple has a mawkish, sweetish taste, and a greater astringency tha any other fruit with which I am acquainted. A little of the juice, however, squeezed into punch, greatly improves that "time-honoured" beverage, which, according to the Ordinary of Newgate, "is nowhere spoken against in Scripture." The shell of the nut is extremely hard, and it has an internal coating, or membrane, containing a caustic juice, so powerful, that if the lips come in contact with it, the skin will be instantly burnt off. The kernel is most delicious, whether it be roasted or eaten raw. It unquestionably contains a very rich oil.

A fish is caught at the mouths of some of the rivers in this country, which, if salted, might, I think, be turned to some account as an article of trade. I allude to the calipever. This fish is considered to be the salmon of the tropics, and, indeed, it very much resembles that prince of the finny tribe in its size, shape, habits, and flavour. The flesh, however, is not red, neither is it so firm as that of the salmon, but it is quite as fat, and infinitely more juicy and delicate. When cut in slices, folded in tissue paper, and lightly fried—which is the only way, in my opinion, of dressing fish, the flavour of which is so volatile, so subtle, so ethereal, that it more resembles an odour, or the rich fragrance of a thousand different flowers mixed and mellowed by distance, than an actual taste on the palate—nothing can surpass it. To subject it unprotected to the ferruginous influence of an iron pan, would be the act of a Hottentot, or a Tartar. Dressed in the manner I have mentioned, it would not have disgraced Olympus, nor offended the critical taste of the Apicii, the last of whom would have refrained from hanging himself whilst a single calipever remained in his fish-pond. The calipever is very excellent when cured, and it is often brought in that state to the Belize market in large quantities. The roe of this fish is very superior, and, I think, almost equals caviare. This is dried, and sold separately. The roe of the calipever is worthy of the consideration of Messrs. Fortnum and Mason.

I have sent you another sample of the rice of this country, and I should be glad to know what is thought of it. There are large tracts of swampy lands in Honduras which are capable of producing rice, but nothing else. If the rice, then, be of a good quality, these swamps would not be altogether lost to the human race.

I have the honour to be, sir,
Your most obedient servant,
R. TEMPLE.

Home Correspondence.

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IRON FOR ORDNANCE.

Sir,—The guns that did not wear out on board the experimental vessels of 1795, were carronades. It is hoped that some of your correspondents may still be able to state whether the fuel used by the Carron Company was mineral or vegetable coal. The ascertainment of this fact would go far towards settling the question respecting the need of charcoal for the casting of iron ordnance.—I am, truly yours, M. S. BENTHAM.

25th January, 1856.

REPLY TO COLONEL BAKER'S REPORT ON COLONEL ARTHUR COTTON'S PAPERS ON THE MATERIAL IMPROVEMENT OF INDIA.

Sir,—In the 136th Number of the Society's *Journal* of last year, the Report of Colonel Baker, secretary to the Government of India, in the Public Works Department, was printed, giving an opinion on the views contained in the papers I have published on Public Works in India. This Report was made in obedience to orders from Lord Dalhousie, the Governor-General.

The Council of the Society of Arts having already shown their appreciation of the subject by inviting me to read a paper upon it, and having further honoured me with their silver medal, I trust that some further discussion of the question will not be considered unprofitable. It is indeed impossible to estimate the importance to this country in every way, and especially in respect of a market for its manufactures, of the material improvement of India; and consequently the investigation of the question, how money may be expended, so as most rapidly and effectively to attain to this, is certainly worthy of any amount of labour, even supposing that it was not a matter of the highest duty and interest to benefit to the utmost so many millions of our fellow subjects.

Before making any remarks on the Report in question, I may observe that the leading points which I have endeavoured to prove in my papers, as fundamental ones in the question of the improvement of India, were:—

1st. That the first thing for India, as for every other country, is to secure, as far as possible, cheap food; that is, that only a small portion of the community should be employed in raising food and the other necessaries of life.

2nd. That after cheap food, the next great desideratum is cheap transit, so that everything may be procured from the localities where, from natural facilities, it can be obtained with the least labour.

3rd. That in a tropical climate, no means for cheapening food can be compared with the application of water in irrigation, by which at least four times the quantity of food, as well as other produce of the land, can be obtained as by cultivation dependent upon the local rains.

4th. That water carriage is much cheaper than any kind of land carriage, and that for very cheap transit no other means can be used but water. Upon the most extensive scale it is proved, both in England and America, that even railway transit, with the help of steam power, is from three to four times as costly as internal water carriage with animal power.

5th. That no kind of transit that is more costly than water carriage will answer for the heavy traffic of a great continental country like India, where the distances are so considerable, that the great mass of the traffic cannot bear the cost of railway or any other land transit, even with the aid of steam power.

6th. That railways worked with quick trains cannot convey the *quantity* that ought to be moved in an extensive country like India with an enormous population. Even in its present state, without even common roads, the traffic on the Ganges is reckoned at 2,000,000 tons per year, while the most crowded railway in England only conveys on an average, over its whole length, 200,000 tons a year, and perhaps not more than 400,000 tons over its most crowded part.

7th. That in the present state of India, while almost wholly unprovided with *cheap* transit, *speed* is, comparatively speaking, quite an insignificant object. To carry travellers at a high speed, while the country is without the means of carrying its goods to market cheaply, is exactly like a farmer keeping his carriage before he has got a waggon.

8th. That even England, the wealthiest country in the world, cannot yet afford high-speed railways, as proved by the fact that money so invested, after a full trial of many years, yields, on an average, less profits than any other kind of speculation whatever. And, therefore, it is certain that an extremely poor country like India cannot yet afford such a luxury.

9th. That what India wants, in the first place, is extensive irrigation and water transit (wherever possible) in *every district*, and not in this or that particular locality.

10th. That there are from 8,000 to 10,000 miles of river at this moment available for navigation, in a more or less perfect degree, and that to improve them, so as to make them thoroughly effective lines of navigation, conveying goods at a quarter or one-eighth of the cost of any land carriage, would not cost more than £100 or £200 a mile, or from a fiftieth to a hundredth part of the cost of the present railways. And hence, to throw away this enormous natural advantage, worth from £50,000,000 to £100,000,000 sterling, and expend our time and money upon railways at the rate of £10,000 a mile, is one of the greatest mistakes that ever was made.

11th. That water is India's greatest natural treasure; that it can be brought upon the land, or used for water carriage at an *expense* not exceeding one-fiftieth or one-hundredth part of its *value*, while the richest gold mines in the world do not yield more than four times the value of the labour bestowed upon working them.

12th. That the actual results of money expended in irrigation works, from the smallest to the largest scale, prove, beyond all room for doubt, the vast difference between the *cost* and *value* of water in India.

13th. That, where the nature of the country and other circumstances render canals unadvisable, cheap low-speed railways should be laid down, as the next best kind of communication for a country which cannot afford high-speed.

14th. That to suppose we are *opening India*, when we are laying a few hundred miles of high-speed railway, in three or four lines, is the most complete delusion. That it is not one line of communication through 20 or 30 districts out of the 120 which India contains, nor even one line through every district that will *open India*; every district requires to be provided by a network of communications. The great bulk of India cannot afford to wait for 20 or 50 years while a single line is opened through a few districts. What does it signify to Gunjam that a railway is making in the presidency to which it belongs, when that railway does not come within 600 miles of it.

15th. Speed of transit over a few hundred miles of communication, is a matter of utter insignificance compared with speed in throwing open the whole country to all the wholesome influences of cheap transit, opening the way for European enterprise and capital into every district.

16th. Beggars as we are, it is of the utmost importance that we should consider well how we can spend our time and money with the greatest effect. To jump at the conclusion that, because England chose to spend £300,000,000 to enable her to travel at 40 miles an hour, therefore, it was the most prudent thing for India to do the same, was just as wise as for a poor man to starve himself and his family for years, while he spent his money in travelling like a gentleman for a few days now and then.

17th. That upon this improvement of the resources of India by a *judicious* expenditure upon public works, depends the prroviding the necessary funds for supporting an effective government, for education, and for every other purpose essential to the welfare of the country.

18th. That the expenditure on public works should be kept quite distinct from the other expenses of the state; capital employed in productive works being essentially different from ordinary government expenditure.

19th. That to execute an adequate system of public works out of revenue, is impossible, and were it possible it would be most unjust to make the present generation pay for that in which they had only a life interest. Almost the whole of the public works of England have been executed by capital on loan, and which is a debt to this day.

It seems to me essential thus, before proceeding to remark on Col. Baker's paper, to show distinctly what the real question is. All the points thus remarked on by me are, as I think, substantially argued out and supported by patent facts.

Now does Col. Baker disprove these things? are his own conclusions contrary to them, and are they substantiated by facts and arguments?

His conclusions are as follows, and I add a short remark upon each:—

1st. "That an imperial system of transit lines of railway, such as have been lately sanctioned, is essentially necessary to meet the military, social, and political requirements of India." No man more heartily agrees with Col. Baker in this than myself, but what in the world has this got to do with the real question, viz., what should *first* be done for India. A patient is bleeding to death, and a spectator begins a long discourse on the best mode of treating him so as to restore his strength, but another says, "Stop a minute, let us first stay the bleeding."

2nd. "That the greater expenditure on high-speed railways is chiefly for objects conducive to cheap working." This is the first time I have seen such a statement, and I feel fully assured that high-speed was the real object, and that if it had not been, nothing like those sums would have been expended on the railways.

3rd. "That the ordinary traffic of high-speed railways should be worked at that speed which will secure the most economical results." Of course, so far as is possible, while the goods trains are pursued by fast ones, obliging them always to work at too high a speed, and eventually to turn into sidings besides, and wait for hours, often for 18 or 20 hours. But what has this to do with the real question?

4th. "That a heavy traffic can be worked more cheaply on a substantial railway than on an inferior one." No doubt, *if they were both worked at the same speed*, but an inferior railway, without any fast trains, can be worked much cheaper than the best with them.

5th. "That a low-speed railway should be worked by animal draught, though made fit to be worked on emergency by light engines." I have nothing to say to this, but that settling a thousand such minor points would not bring us any nearer to our object.

6th. "That the guage should be 5ft. 6in." The same remark applies to this.

7th. "That such railways were applicable only as branches to trunk lines, and in localities where the traffic is light." Or, he might have added, where we cannot yet afford to have such as will cost more time and money.

8th. "That activity of construction being dependent on the supply of iron, may be four times greater for an inferior railway than for a superior one." Then he grants the whole question about high-speed and low-speed railways. For I am sure no one can show that it would be better to have 1,000 miles of high-speed railway than 4,000 of low-speed, or 10,000 of the former than 40,000 of the latter, or 100,000 of the former than 400,000 of the latter.

9th. "That the system of coast canals, proposed for the Madras presidency, appears to promise very beneficial results."

10th. "That canals in situations suited for their construction are preferable to low-speed railways." These conclusions also have little to do with the question.

11th. "That great speed in canal and river navigation is not likely to be attained in India." This, also, is not the question. It is certain that a speed fully sufficient for our main present purpose is attainable—a speed of from three to eight miles an hour.

12th. "That the improvement of rivers and formation of canals will not tend immediately to extensive boat navigation where it was before unkown." Somebody well remarked, if there is a man in the world that knows the difference between 99 pice and 100, it is a native of India. Only make a water communication that will carry in the least degree cheaper than the land one, and no people upon earth would sooner take advantage of the opening.

13th. "That the most perfect system of railways and canals will not supersede the necessity for good cart-roads."

It will be seen, on comparing these conclusions with the points I have remarked upon, that most of them do not really at all meet any of the great points. And that as to the essential questions, Whether irrigation is the grand means to relieve the people from their present enormous labour in procuring the necessaries of life, about which three-fourths of the population were now employed? Whether it is advisable at present to spend millions upon high-speed railways, rather than upon irrigation, navigation, and low-speed railways? Whether the high-speed railways can carry the great traffic of the country? Whether the cost of transit on these railways will not prevent five-sixths of the traffic there ought to be? Whether it is not the greatest mistake and injustice to leave 100 districts almost untouched, while a single line of communication is made at an enormous cost through the remaining 20? Whether the general improvements of the country by means of irrigation and cheap communications is not the only thing that can provide funds for all other improvements? As to these essential questions, literally not one word is said, yet these were the questions raised, the questions upon which Lord Dalhousie wanted a careful opinion, and (as I must insist) the real questions upon which the welfare of India depends.

Having thus called attention to what Col. Baker does not say, a very few words will suffice for what he does say, as it is my particular object not to lead people away and occupy their attention with matters of comparative insignificance. This has been the grand mistake hitherto; while men have been discussing *what the guage ought to be*, they have forgotten that not one hour had been given to the discussion of the question whether railways ought to be commenced upon at all in preference to any other works.

I must notice the candid and perfectly honest way in which Colonel Baker has remarked upon my papers, so honourably contrasted with the tenor of the writings or speeches of others who have attempted to oppose my views. Colonel Baker commences by stating that "the consideration of this question has left me deeply impressed with the importance of the subject, and though I dissent from many of the views expressed by Colonel Cotton—and though I dispute many of his calculations, I cannot but feel that he argues from sound principles, and that his plans for the improvement of communications at small cost in some localities, by means of canals and rivers, and in others by an inferior class of railway, are eminently deserving of attention."

In the 3rd paragraph, with respect to the data on which my calculations are made, of course I was under the necessity of arguing from such data as we had. With respect to new works, especially those of irrigation, we have abundance of conclusive data; for others, such as railways, we had no Indian data to signify, and I could only argue from those of England and America. But we must begin somewhere, and till we have conclusive data, we must make what use we can of such as we have. The difference between the railway men and myself is, that they at once began to lay expensive railways without any discussion whatever; I investigated the subject as far as I could by means of such data as we had, and showed that these data were quite sufficient to prove this, that it was a grievous mistake to spend £10,000 a mile upon railways that would neither give us cheap transit, nor carry a quarter of the traffic that ought to exist.

Colonel Baker says nothing in answer to any of the fundamental calculations or arguments, from which I conclude that they were unanswerable, but then he should surely have acknowledged the legitimate inferences—viz., that money ought first to be spent in navigation and cheap lines of transit.

In the following paragraphs he compares a low-speed with a high-speed railway, and intimates that the former could be constructed for one quarter of the cost of the latter, which, as I have before argued, clearly decides in my favour—viz., that the former ought to be executed in preference to the latter.

The only further remarks that it seems necessary to make in these paragraphs, are these:—Ist. Colonel Baker does not seem to be aware that all passenger railways are worked at a speed for goods above what is economical, and that what with pushing on the goods trains at high speeds, and keeping them waiting for hours in the sidings, the waste of money is enormous. 2nd. I do not propose any one kind of railway for all lines. I would make them of various weights of rail, &c., to be worked with light engines or animals according to the circumstances of the case. 3rd. Colonel Baker is entirely mistaken in supposing that American railways are worked at nine-tenths of a penny per ton per mile, and English ones at one farthing, "in consequence of the latter being more solid structures." Goods are carried at a less *cost* (not *charge*), on American railways than in England, because, having few passenger trains, and those (excepting on a few lines) worked at lower speeds than in England, the goods traffic is not so much interrupted. No goods are carried in England at one farthing a ton, and it is pretty certain now that there is no actual profit (on the passenger lines) on goods carried at one penny. I had myself supposed that the statements that goods could be carried at one halfpenny per ton in England were true, but I find that they are quite false. A railway official thoughtlessly, one day, explained this by saying, "We were obliged to charge only one halfpenny a ton for the transit of *our* coals, because the price we sold them at would not allow more." When the railway companies are also coal merchants, nobody can say how the matter really stands between the two trades they carry on. Just as it was with the East India Company formerly, when they were both kings and tea-dealers.

A gentleman whom I asked about this point, and who had managed the conveyance of 100,000 or 200,000 tons a year, told me that the total expenses were rather under a penny, on a road that was worked at low speed, and with little interruption from passenger trains. But the result of much inquiry is, according to my opinion, that, allowing for wear and tear, management, accidents, and other items at a fair price, goods cannot be carried profitably in England, where there are many fast passenger trains, at a penny a ton. And the increase of goods traffic, accompanied with a diminution of dividend, which is now so general, is a strong support to this conclusion. In the late railway reform meetings, it has been declared by all, that goods were carried at a loss on the English railways. 4th. Colonel Baker thinks the Calcutta railway will only cost £8,000 a mile, but the 120 miles already opened have cost at least £120,000; and the managing director of the Bombay railway says that line will cost £10,000 per mile on an average. 5th. In Colonel Baker's estimate of the respective *charges* that must be made on a low-speed railway, he makes the mistake of supposing that the same *quantity* will be carried at a low charge as at a high one. The fact is, that it is the great fundamental principle of transit that *the lowness of the charge produces the traffic;* probably, if the charge is reduced from four to one, the traffic will increase from one to ten. When the rate is reduced very low, as on the canals and rivers in America, enormous masses of goods of little value are set in motion, not a ton of which could move at high rates. The granite slabs of Mysore, which are not now moved ten miles, would probably be carried all over India, if there were a system of steam-boat canals conveying such goods at one-tenth or one-sixteenth of a penny a ton a mile.* 6th. What Colonel Baker says about the impossibility of carrying more than 16,000 tons of iron per annum to India, was curiously answered by a great ship-owner to whom the subject was mentioned. He said, I do not know what all England could do, but I would undertake to send 100,000 tons a year. To suppose, from some momentary difficulties, that we should never be able to send out more than 16,000 tons a year, for want of freight, is absurd.

Colonel Baker next says I am unreasonable in supposing that the past rate of progress in railways will be the measure of the future. But my quarrel is not with the laying so many miles, but with their laying any at all, at present. The more they lay, the greater waste will there be. If he says that in future 1000 miles a year will be laid, then I say that the same money and labour would improve 50,000 miles of river, if there were so many, or make 5000 or 10,000 miles of canal or light railway, or irrigate so many hundred thousand acres. It is a strange argument to use, in answer to my charge, that every mile of high speed railway is a most grievous waste of money, that we are not going to lay 1000, but 10,000.

Colonel Baker next says, that my assertion is quite unfounded, when I say that its inability to carry all the traffic of the Ganges quite overthrows all the calculations of profit for the Calcutta Railway. Before he thus accused me, he should have inquired, and he would have found that the calculations of the profits of the railway were expressly made on the supposition that the whole traffic of the Ganges would be transferred to it, and upon this a profit of 18 per cent. was expected. It is Colonel Baker's assertion that is unfounded. This unfounded charge is a great blot in a paper otherwise so fair; it is evident that Colonel Baker never saw the original reports upon which the railway was undertaken. Colonel Baker says, "by this and similar arguments," &c.; I can only say that, throughout my papers, I use no unfounded arguments whatever. He goes on to argue that high-speed railways have peculiar advantages. What can be the effect of saying these things, when nobody is further from denying them than I am, but to draw away attention from the real question upon which the welfare of India so much depends—viz., is it advisable to provide a few isolated lines for high speed at an enormous expense, while the whole mass of the country is without irrigation and without cheap transit? The only other effect can be to convey a totally false idea of what I say, which I am persuaded was not Colonel Baker's *intention.*

He then, curiously enough, expresses *his regret* that one who is *apparently* anxious for the welfare of India, should direct his influence against a system which he is fully persuaded is most injurious and destructive, and against which he has brought to bear arguments which he is quite sure never can be answered. Probably nothing could have been invented more sure to hinder the progress of Indian improvement, than thus to show the British capitalist that all his horrors of Indian investment is more than justified by the exhibition of millions so expended as to leave a doubt (from the results of both the Calcutta and Bombay Railways), whether such works will even pay their expenses. The last Reports of both these works show a profit of about 1½ per cent. per annum, while both the permanent way and rolling stock are quite new, and scarcely anything has been expended on their repairs and their wear.

Whereas, had two or three millions been expended on rivers, canals, irrigation, or light railways, so as to yield 20 or 30 per cent., it would have drawn the attention of every capitalist in England to the country.

Colonel Baker then says it is superfluous to enlarge upon the importance of river navigation, &c., which is all the answer he can find to my argument on the absolute necessity of water carriage. I must claim this as a full acknowledgment of all that I say on that subject. He says that he "allows that canals and rivers can *compete* with railways for the goods traffic." This also is calculated to misrepresent what I say. I do not say that canals can *compete* with railways for goods; I say that the *cost of transit by rail is absolutely destructive of the great traffic of a continental country*. That what Dr. Lardner says is literally true—"that goods generally cannot bear the cost of railway transit," and consequently, as shown in America, that where there is not water transit, the great mass of goods are not moved at all, and all trade in them is prevented. If it were not for the water lines from the Upper Mississipi Valley to the Atlantic, not one barrel of flour would be shipped out of one hundred that are at present brought down.

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* The Telegraph supports, 15 ft. × 18 in. × 9 in., cost fifteen-pence each.

In his remarks on the project for cutting a canal from the East to the West coast of the Peninsula, Colonel Baker leaves out of his argument in favour of a railway, the simple fact, that if the latter were laid, the main traffic would not go by it, as it could not bear the cost of 350 miles of railway transit. Even were a railway laid, the canal would be required almost as much as it is now.

Colonel Baker's argument about the proposed weir across the Ganges, to turn the water into the Nuddeuh river is also very curious. He argues, that if the river wanders about now, when there is no artificial work to restrain it, what would it do when such works were executed; that is, if the river strays when it has nothing heavier than a grain of sand to resist it, what would it do, if an engineer put stones of half a ton in its way. I think we may safely answer, without presumption, that it would be as tractable as the Godavery, Kishnah, Cauvery, &c., now are with the engineers' bridle on them. The Santhals burnt and massacred wherever they pleased at first, but their wanderings and plunderings have not been extended by their encountering disciplined troops.

Colonel Baker speaks of this project as if it were a new and wild scheme, and makes no allusion whatever to the fact, which he was well aware of, that just such rivers, flowing through the same alluvial deposits, from one half to four miles broad, and with much greater falls than the Ganges—viz., from 1 foot to 3½ feet, (while that of the Ganges is less than half a foot), have had weirs thrown across them, and have not been permitted to wander for many years. Surely in arguing upon this point, it would have been but his duty to have given the Governor-General some reasons why he thought what had been done with exactly similar rivers could not be done with the Ganges.

Again, in his remarks about the extension of the Ganges Canal to Calcutta, he speaks of the obstacles, but says not one word on the two points, What would be the cost of overcoming them? and, What would be the value of the navigation? All such *arguments* as Colonel Baker uses amount to nothing, unless these two questions are answered. Colonel Baker gives us no estimate whatever of either the cost or the value of such a work. The Ganges Canal, with its enormous works, (an aqueduct that cost £300,000, &c.), and its vast dimensions, (60 yards broad, and 10 feet deep at its head,) has cost, I believe, under £2000 a mile. Does Colonel Baker think its extension would cost as much as the railway, £10,000 or £12,000 a mile? It would certainly be far more valuable than a railway. A single pice a mile (⅛d.) saved on every ton of the present stated traffic, (2,000,000) would give a return of £1000 a mile, the interest of £20,000 a mile, and were it executed, and goods carried at ⅛d. a ton, we may be certain that in a few years the traffic would increase to 5,000,000 tons, especially considering that the lines of communication from the interior to the Ganges would also be so improved as greatly to reduce the cost of reaching the water line.

Colonel Baker next states, more particularly, his doubts whether the natives will always take advantage of water carriage, and that the Jumna canals have not been used for the transport of goods, and that even when the government took steps to encourage the use of them, and an East Indian accepted their offers, he soon abandoned the attempt. No doubt, however, from some imperfection or incompleteness in the canal, the transit was not profitable. He adds, that the frequent failure of water at the extremity would have been quite incompatible with steady navigation. No wonder that they were not navigated. If the European engineer is so insensible to the importance of the subject, and the value of cheap transit, that he does not go to the small trouble and expense of making the canals really effective navigations, how is it possible that the natives can make use of them. Such a case occurred in Madras. The engineer turned the water out of a line of canals, in the hot weather, without giving any notice of it, and when asked why, he said it was of no consequence, because so few boats used it. If the boatmen had been asked about it, they would have said, how could we make use of such a line, when we never knew whether we should find any water in it or not.

To suppose that people will persist in carrying goods at a greater expense by land, when they could carry them cheaper by water, is surely unreasonable. He says that I stated that not a ton was carried by the Godavery above a certain point, from want of enterprise in the natives, and the interference of the petty Zemindars on its banks. It was the business of the government to remove the obstacles. The Zemindars stopped by force all boats, and levied from them whatever tolls they pleased, and so totally destroyed the value of the communication. It is just the same with such a case as it is with other improvements. If the natives had, in their present state, sufficient enterprise, they would form companies and execute irrigation works, but it is evident that as yet there are certain things we must do for them. Had the government put a stop to the oppressions of the Zemindars, I am quite sure that the river would have been as constantly navigated in its upper part as it is in its lower. The Zemindars were so senseless, that they demanded such enormous duties as to render the navigation more expensive than land carriage. To suppose that the boats which swarm on the Lower Godavery would not go up the river if they could do it profitably, is to suppose what is inconceivable.

In his 39th paragraph Col. Baker says, he is not sanguine about the cheapness and speed of transit on the rivers that I expect, and that the steam-boat department of Government has had the experience of twenty years. To this I say, 1st, have the government tried the effect of spending £10,000 a mile upon the water, as they have upon the land. They almost totally neglect these magnificent navigations, spend upon them either nothing at all or less than the thousandth part of what they are worth, and then say, what miserable navigations they were; and yet even in this neglected state, they carry goods at one-fourth the cost that railways can carry them. 2nd. How invariably this is the excuse for doing nothing, "it has been tried." To suppose that with the comparatively insignificant experience we have had in steam navigation on rivers in India, we have discovered all that can be discovered, is the height of delusion. There is nothing of which I am more certain, from what is now actually done on such unmanageable rivers as the Rhone, &c., than that, even in their present state, the rivers in India may be navigated by steam both much cheaper and much quicker than they are now.

In the 40th paragraph, he speaks of boats going at three miles an hour, that they may not make a ripple injurious to the banks of canals. How strange it is that people continually talk in this way. Because little narrow winding canals, not intended or adapted to steam-power and high speed, and without a foot of land to spare on either side, are liable to injury, therefore, canals must always be injured by high-speed, though they are constructed so as to bear it. Do men argue that the new railways cannot be worked at high-speed because the original tram-roads will not bear it. The banks of canals can be protected from the ripple at an insignificant expense. Even one of the canals in England is actually worked by steam at seven miles an hour, without any protection to the banks, and had about one per cent. been added to its cost at first, it would have borne any speed.

Colonel Baker then estimates the cost of river transit at $\frac{3}{8}$ths of a penny per ton; but it is only what he reckons the average at present on the unimproved rivers, and he allows nothing for the change that might be effected in the rivers at a comparatively trifling cost.

I have passed over the paragraphs where Colonel Baker speaks of the proposed improvement of the river navigation by storing water in tanks in the monsoon, and discharging it into them in the dry season. Colonel Baker thinks this worthy of examination, and so far agrees with me; but when he says the great drain on the Jumna and Ganges, to feed the irrigation canals, confers additional interest on any promising scheme of compensation, he by no means places the matter in its true light.

The water proposed to be turned into the Ganges canal, nearly a million cubic yards per hour, is stated to be about half of the total quantity of water in the lower part of the river. Now the abstraction of nearly half the water of a river which is so shallow at places that every inch of depth is of importance, and steamers drawing $3\frac{1}{2}$ feet are constantly getting a-ground, would be utterly ruinous. The great highway of Bengal, the thing upon which the whole present state of things depends, would be essentially obstructed. The reduction of a foot in the depth of the water would not merely stop the present steamers, but would, probably, treble the cost of transit by the native boats, and for five or six months in the year, stop at least $\frac{3}{4}$ths of the trade. The mischief arising from this would be really incalculable. This is carefully argued in my papers, and surely it was one of the points in which the Governor-General might have expected some distinct conclusions supported by arguments.

Colonel Baker appends to his paper a table of the cost of transit by different means, viz., ocean, river, canal, railway, &c. If my papers had produced no other effect than the further exhibition of such a comparison, I might have been satisfied. Though Colonel Baker has not drawn from it the legitimate conclusions, most assuredly others will.

Take, for instance, such a calculation as this. By this table, the Ganges transit by country boats is, at present, with the river unimproved, about $\frac{1}{4}$d. per ton per mile, uninsured. But $\frac{19}{20}$ths of the goods conveyed are of such small value (from £2 to £3 a ton) that the insurance would be very trifling. By the railway, even the lowest rate is 1d. a ton, after spending £10,000 or £12,000 a mile upon it. The difference calculated on two million tons, carried 600 miles, is no less a sum than four millions sterling a year, the interest of eighty millions. And supposing the river transit were destroyed, and goods had to be carried by rail at 1d. per ton, or four-times the present cost, we may be quite sure that $\frac{9}{10}$ths of this traffic would be destroyed.

It is a very great point gained to have the comparative cost of transit brought into broad daylight. Intelligent men will certainly be thus led to consider this question a little more earnestly. Hitherto, universally, railway transit has been spoken of both in England and India as exceedingly cheap, cheaper even than water carriage.

In the United States, the difference of the cost of the two modes is well known, and the effects of it clearly shown. On the Erie canal, a through traffic of about 300,000 tons a month is conveyed, during the seven months that it is open, at a *charge* (not *cost*) of $\frac{1}{2}$d. per ton per mile; and on the parallel railway the through traffic, during the five months that the canal is closed by frost, is under 10,000 tons a month. The report of the state engineer of New York, for 1853, is full of the most important information on this subject. The following are the *costs* of conveyance by different modes as given in this report:—

Ocean, long voyage	$\frac{1}{18}$	of a penny.
Lake, do.	$\frac{1}{9}$ to $\frac{2}{9}$	,,
Hudson river	$\frac{1}{7}$	,,
Erie canal	$\frac{2}{9}$	,,
Ordinary canals	$\frac{2}{7}$	,,
Coal railways	$\frac{1}{3}$ to $\frac{4}{9}$	,,
Favourable passenger lines	$\frac{7}{10}$	,,
Passenger lines with steep gradients	$\frac{6}{7}$ to $1\frac{2}{5}$	,,

This is the actual *cost* of transport without the interest of the cost of the works, which will, of course, be much less on the canals than on the railways, because the former are capable of carrying so much larger quantities. The *charge*, as before stated, is consequently more than three times as great on the Central Railway as on the Erie Canal. And this difference ($1\frac{1}{4}$d. per ton per mile) is sufficient to stop the whole distant traffic, with a trifling exception (only $\frac{1}{30}$), for five months in the year, in a country where pretty accurate calculations are made.

In his 42nd paragraph, Col. Baker says, again, that inland water communication will not answer the important purposes of a (high-speed) railway. Does anybody argue that a waggon will answer the purpose of a carriage and four. But if, from this, we jump to the conclusion that, therefore, a farmer ought to *begin* by giving £300 for a carriage, instead of £30 for a waggon, he would certainly leave a considerable gap in his argument.

In conclusion, I beg to call attention to the decisive proof which this Report affords of the complete *misapprehension* of the subject of Public Works for India (and especially of communications) which exists. The Govenor-General calls upon his consulting engineer for his opinion upon papers in which the subject is attempted to be discussed, and the Report forwarded in obedience to this order, scarcely touches upon any of the really fundamental points in the question. The results of Colonel Baker's investigation were given in 13 conclusions, *not one of which* affects the real questions at issue—viz., what works, considering the circumstances of India, should be first executed? If everyone of these conclusions were fully granted, they leave us exactly where we were. We have in fact arrived at conclusions before we have begun the discussion.

I remain, yours obediently,
ARTHUR COTTON.

P. S.—With reference to what Colonel Baker says about railways carrying at one farthing a ton a mile, I cannot help quoting a passage from the New York State Engineers' Report for 1853.

"At the Railway Convention held at New York, embracing the officers of the four great lines between the Atlantic and the West, a joint Report was submitted, stating, that 'experience has proved that the lowest rates at which ordinary freight (carried in freight trains at ten or twelve miles an hour, and in large quantities), can be carried to pay interest [on lines costing only £5000 or £6000 a mile] and expenses will average about a penny per ton per mile for heavy agricultural products, three halfpence for groceries, and two-pence for dry goods." At a subsequent Convention of the railway companies of Ohio and Indiana, similar rates were adopted. The above charges applied to the business of one or two great roads, would yield an average of a little less than three halfpence, and would serve to show, *that some of the business done on each of these roads does not even pay interest and expenses.* Sufficient information has been elicited from the railroads of this and other states, from the reports of conventions and other sources, to warrant the belief that a considerable portion of the freighting business now done by our railroads *yields no profit at the present rates*, when due allowance is made for the increase of capital which it requires for the increased wear and depreciation of the works, and for the occupation of the line to the injury of the other business.

No unbiassed person can read the later reports of the English railways without being satisfied that this is at least as applicable to them as to those of the United States.

The Mail just arrived from India contains the following:—" The Bengal Coal Company have not yet been able, say the Directors, to make any terms with the Railway Company for the conveyance of their coal. They intend, therefore, to trust to the Damooda." That is, after spending £12,000 a mile upon land communication, calling in all the engineering science of the West, and adding the trifling aid of steam power, the railway is actually beat by one of the worst river navigations in India, worked with human labour, and in which not an atom of engineering skill, or one shilling of outlay, has been expended.

TONNAGE REGISTRATION—BRITISH SHIPOWNERS.

Sir,—I have been reading Mr. Atherton's Paper upon "Tonnage Registration," which appears in the *Journal of the Society of Arts* of the 18th of January, as also the discussion upon it, and a letter from that gentleman in a subsequent number of that useful Journal. He does not appear to hold a very exalted opinion of "paragon shipowners" and "heaven-born millionaries." In fact, it is quite impossible that he, or any upright man, can hold a high opinion of even "shipowners, as a class," *if*, as he says, they are merely "honest *as times go*," who, he says, are "certainly not purists," and who, as his letter would all but imply, "go on wrecking *well-insured* ships at the rate of 1,799 ships per annum." The italics are his own. It is ridiculous to suppose, that he could hold an exalted opinion of them. But I think before expressing that opinion in public, he might have adduced some well-founded reasons for it. It is strong, and required a reason. It might not, however, have been convenient for him to give any, or perhaps he was not able to lay his hand upon one for the moment, and for these reasons, I will, for the present at least, deal gently with his unwarrantable, and I may say unfounded remarks, about shipowners as a class. We differ in opinion upon that point, and we part with this hint, that before he again impugns the character of any body of men, he had better produce proof that he is justified in so doing. But there is one point on which we are sure to agree. Shipowners understand their own interests. By the way, Mr. Atherton denies that, for he argues that *he* understands their interests far better than they do. I am sure, however, he will not deny, that they understand what affects their breeches pockets. Is that the great "mystery of their craft?" Well, then, if the " paragon shipowners and heaven-born millionaires are causing the printing-press to overflow with their ecstacy in approbation of the restricted registration prescribed by the Merchant Shipping Law of 1854," and if that law, as he argues, instead of tending to check the enormous losses annually, tends to increase them, how will that affect their breeches pockets? *Not* in the way he seems to suppose. When a ship of mine is wrecked I lose one-half, as I only insure one-half. When Mr. Gilmour loses a ship, his pocket is minus her value, for I believe he never insures at all. At least his late firm did not, and there are many other shipowners who act as we act, and therefore we support the Act of 1854, because we believe that, so far as any Act of Tonnage Registration can affect the safety of shipping, that Act is preferable to any we ever had, or any that was ever propounded. But surely, he cannot think that " even shipowners as a class," are rogues, for such they would be, if they insured their vessels above their value, and did not adopt every precaution to ensure their safety upon the voyage; and he forgets, or perhaps he does not know, that if they acted in the manner he seems to think they do, they would invalidate their policy of insurance; and that if they wilfully lost their vessels, they would be subjected to one of the most severe criminal punishments. He seemed also at the time to forget, if he ever knew, that they were subjected also to very heavy *pecuniary* penalties. Mr. Mitchell (who, to his credit be it said, could not sit in silence and hear shipowners slandered) told him plainly, at the time of the discussion, that they were. These, in his letter, he *partly* enumerates; but he overlooks by far the most important of all; and for that penalty I would refer him to the case of the ship *John*, which was decided only the other day. There he will see one of the very heavy penalties to which shipowners are subjected. He appears also to forget, if he ever knew, or ever thought about it, that it is *not* to the interest of shipowners to have their vessels deeply laden. Their interest is to make their voyages quickly; and that they cannot expect to do if deeply immersed in the water. And he overlooks altogether the important fact that commanders and officers will not sail in ships where their lives would be placed in more than ordinary jeopardy, and that no law can compel them to do so. I reason with him, as you will perceive, upon matters which affect simply the lives, the pockets, and the personal freedom of owners, and masters, and officers of ships, as he unquestionably appears to hold the opinion that they have not a soul to soar above any one of these. On anything loftier connected with them, it would be waste of time for me to argue with one who, while he holds so exalted an opinion of himself, can hardly, by any possibility, hold more than a very ordinary opinion of others.

I make no pretensions to scientific knowledge. Mr. Atherton does. He wanders in its loftiest regions, and it strikes me that he often loses himself in those clouds which keen eyes alone can penetrate. His position gives him the *entrée* to those lofty regions of science, but his production warrants me in thinking that he has been elevated to a sphere for which Nature never intended him. Pray ask him to step down for half-an-hour to Mother Earth and common sense, and forgive me if I cannot talk about parallelograms and parabolas, for my training was in the forecastle of a ship.

Well, then, Mr. Atherton no doubt holds a very comfortable appointment. That being so, I presume he would not give it up till he secured a better. He tells these purse-proud, stupid Shipowners, who he is quite certain " do not sigh for the public good," that the present mode of Tonnage Registration is a very imperfect one. But acting as he would act himself, those Shipowners do not feel at all disposed to give it up, unless he, or someone else, can produce a better. That is quite reasonable, you will admit. Nay more, as it is exactly the same as he would do in any matter where his own interests were concerned, he must allow that it is a very wise course for such a set of very ordinary mortals to follow. But he will also say, he has proposed a better, and that he made known his plans to the Executive, while the Bill of 1854 was in abeyance; but that those who had the framing of the Merchant Shipping Law of that year would not adopt them. I dare say not. No wonder. How could he expect them to have faith in that, the principles of which even now Mr. Atherton knows not how to put into practice? His principle of Admeasurement is based upon displacement—at least, he tells us so; and when Mr. Scott Russell, who I am sure listened with great impartiality to the paper, asked " what his idea was as to the *possibility* of finding a load water-line, and as to the means which appeared to be within reach for determining it," Mr. Atherton seemed sadly puzzled. He said it would be a matter for " serious consultative deliberation." Of course it would; but that is the *basis* of his theory. Till he determines that, all his figures and rules are worse than worthless. Men of the earth cannot build castles in the air; men of the clouds often do, but they vanish with the idea that created them. They must have a foundation. Let Mr. Atherton give me *his*, and then I may talk to him even more fully about the structure he intends to rear for my benefit as a Shipowner. He says he has one, but he admits it is only in embryo. It may well be so, for I fear it will never get further. He supposes "a ship to have a 30-feet beam;" then he says, "the deep draught water-line might be fixed at a certain proportion of the beam—say a fourth, or a fifth, or a sixth below the main deck." Now, what does this empirical range of from one-fourth to one sixth give in a ship of 36 feet beam, or about 1,000 tons register? It gives a range of no less than three feet; and if, as he acknowledges, the water-line of this ship may be fixed at three feet higher or three feet lower, which in a vessel of 1,000 tons involves no less than 380 tons of dead weight, it surely is nothing short of arrant nonsense to speak of dead weight cargoes being properly arrived at by the means he proposes. To tell the public that he can—as if he held a conjuror's wand—arrive at that which has baffled the inquiries of both practical and scientific men for ages, by a mere call of "Presto," is Quixotic in the extreme.

To the best of my recollection a plan was introduced some few years ago, when Mr. Labouchere was President of the Board of Trade, for a new mode of admeasurement. It, too, was based upon displacement, or rather upon external measurement and the *principles* of displacement;—upon the established principle that a ton of iron displaced a ton of water, and, therefore, 1,000 tons of iron, or any other description of weight, would displace 1,000 tons of that fluid. This was sound and perfect, as far as it went. A bill was introduced; it passed the first reading. No one could discover anything wrong in it, and for any one to attempt to offer any objection, seeing the vast piles of blue books, and "diagrams and sections, and curves of areas," which were printed about it, would have appeared the height of imprudence. So thinks Mr. Andrew Henderson to a great extent still (who, by the way, has got a pet scheme "of his own," which I can hardly call by a clearer name than the roomage-displacement-tonnage plan, for it is a jumble of Mr. Atherton's roomage, and the exploded plan now under notice, and one originating in his own brain about the cube-contents of water, which he, somehow or other, turns into register tonnage, in the shape of very muddy water indeed). It, however, struck a very plain man that merchant ships are not always laden with iron or other dead weight, and that to find out the displacement it would be necessary so to load them, and he had the audacity to ask the very "scientific" gentleman who planned this new mode of measuring ships, the following rule-of-three question. If 100 tons weight of iron displaces 100 tons of water, how many tons of water will 100 tons measurement of hat-boxes, or Manchester bales, or cork, or tea, displace? The "scientific" gentleman could not answer till he had had an opportunity of putting the hats, the bales, the tea, or the cork into scales, and weighing them. He then, for the first time, thought that merchant ships really *did* carry other descriptions of goods besides dead weight. The public never heard anything more of the scheme upon which the bill that passed its first reading had been founded, and before the government ventured to introduce another, they made sure that it was perfectly practicable. Mr. Atherton has given no reason to show that his plan would not meet with a similar fate were any government good-natured enough to introduce a bill upon it.

But I will follow his proposed legal load-line a little further. Suppose, for the sake of argument, that that line has been fixed upon as a mean, for instance, of the above range, and that the ship of 36-feet beam goes to sea, and that she is found to be crank, leewardly, and unmanageable. What would the owner do? He would, from his knowledge of those things, desire to bring her down a few inches. That he could not do, although the legal line might just as well have been fixed according to Mr. Atherton's range, at 18 inches higher. He would be obliged, therefore, to his great injury, to be satisfied with his ship, rendered bad by law, when probably she would prove a superior vessel if no such parliamentary interference existed between him and his property.

Here, then, is a vessel, with a legally-fixed displacement, condemned as a model, whereas, under a different load-line, she might prove a very superior ship. She would be stamped with a false character by Act of Parliament, and this false stamp would form the basis of that inductive science which, according to Mr. Atherton's notions, would so improve the models of our Merchant Navy, that not only our lives would be safer, but the very bread of life itself would be thereby cheapened. How can the Chief Engineer of a Royal Dockyard gravely propound such gross absurdities?

But let me trace his views a little further, for I have not done yet. I may choose, or I may have reason to build a ship of such a depth in relation to the breadth as would bring the proposed legal load-line actually below the keel, and thus my ship, to conform to the law, must be made to sail in *the air!!* Would she not? What would brother Jonathan say to that? He constructed a ship "to lick creation," which was such "a mighty goer," that she never wanted more than "a drop of dew under her bilges"!!! Our American brethren are fond of a joke, and they know it to be one. Mr. Atherton, however, says in all seriousness, that we should make a law which will compel British ships to float in the air!!—to lick the licker of creation by Act of Parliament!!

He further says, the marking of the load-line on "colliers" was enforced by Parliament. This is a grave misrepresentation, which he will find by again referring to "Moorsom's Review of the Laws of Tonnage," from which he has taken the whole of his historical view of the question. He will there see that only *keels* were so nailed and marked; and keels, I may add, are open barges, only employed in loading colliers.

He also says that the load-line of men-of-war is *fixed*. Now, on this matter he ought to be an authority, but even here he is not correct, for they are continually altered by the addition or subtraction of ballast, whenever their sea-going properties show it to be desirable. Thus, the only two authorities he attempts to bring forward in favour of an enforced load-line are misrepresentations, and to enforce such a line by Act of Parliament—a line which even he cannot discover—would, so far from being beneficial, prove most injurious, in my humble opinion, to the science of Naval Architecture, and which I desire to see improved quite as much as any one who ever gave any attention to the subject.

Now, one word, and one word only, as to the proposed "Light Water-line." Mr. Atherton desires to have that fixed, too. It may be easier than to fix a load-line; but, practically, it cannot be obtained. An owner would require to complete his ship for sea, before taking any cargo on board, and after the most complete equipment—with stores even for an 18 months' voyage—many vessels would not stand upon their legs without ballast. How, then, would he meet these difficulties—and would he, by an Act of Parliament, enforce that which was not practicable? And where would be the true Light-line, with ballast on board?

He says that the existing law, as regards its practical operation, cannot be carried out by the practical measurer. I was struck with this statement, and made inquiry at the proper quarter. I find this, too, a mis-statement. Mr. Atherton, and one or two who think with him, say that the dimensions only are taken by the practical officers, and that the calculations are made in London. Now, I learn that the whole tonnage of the vessel is completed by the officer who measures her, and which is sent to London only for examination. I find, further, that the document transmitted for examination is almost invariably returned in course of post, and I cannot learn that one single complaint has been made of detention through this most desirable system of proving the tonnage. I need hardly tell any one conversant with the subject, that the errors existing under the tonnage of the late law, show the *absolute* necessity of a check under any system that might be established. I can excuse him for a fallacy in theory, but not for an error in fact, which he ought to have known before circulating to the extent he has done his scheme of Admeasurement.

But the most triumphant answer I can give to the objections to the existing law on account of the difficulties which it is said to create, is the fact, that though more than 3,000 vessels have been measured by it, vessels scattered over every part of the kingdom, even to the most remote creeks of Ireland and the Highlands of Scotland, no difficulty whatever has been experienced in carrying out the law; and from all I can learn every practical officer states that it is more simple than the late imperfect system, even though more measurements require to be taken. "Paragon shipowners" may well cause "the printing press to overflow with ecstacy in approbation of a law" which, while it leaves them to build those forms of ships best adapted for competition with other nations, checks fraud, aids them in their ocean race for supremacy, and is at the same time so simple that the most illiterate officer of Customs can easily be made to understand its mode of application. If Mr. Atherton can propose anything half so good, he will stand higher in public estimation than he is likely to do after a perusal of his present paper.

But though it is little better than waste of valuable time for me to examine the nature of the structure when he has failed to show any foundation on which it can be reared, I will, as the pen is in my hands, venture a passing remark on the method or rule proposed for calculating "roomage," and dead-weight cargoes. And here let me ask—why change the word tonnage into roomage? Tonnage, as I understand it, applies to both weight and measurement. And the greater the register of a ship by the present mode of Admeasurement, the more she carries (of dead weight) and stows (of light goods). Thus from the present Register Tonnage a calculation can easily be made of what she can carry and stow, far more accurately than any other law or plan I ever heard of. The cube contents of her hold are known. The shipowner contracting for specified dimensions and model, knows exactly what he will obtain; and the merchant chartering —(and this is of far greater importance than Mr. Atherton seems to be aware of)—knows exactly the space he engages, for it is inserted upon the Certificate of Registry, in tons of 100 cubic feet each. No former law gave that most valuable information. The old or Builder's Admeasurement, was so far out that a ship of 20 feet depth, and with a capacity twice as great, registered no more than a ship of 10 feet depth; and, by the subsequent law, the hold of a vessel might be constructed in various ways, without in the slightest degree altering her Register Tonnage.

But to the proposed mode of ascertaining "roomage." Mr. Atherton says that the depth of the ship is to be divided into three parts, one to consist of the hold from below to the light-line—a line, by the way, he has not yet discovered; the other from the light-line to the *load-line*—a line he will never discover; and the remaining part, from the last imaginary line to the upper deck. Then he says, that the cube contents of the lower part is to be found by multiplying the length of light-line—a line he knows not—into its internal breadth, and after that into the depth. This, he says, will give the circumscribing cube, or box of the lower part; and he gets the body of the ship by taking 40-100ths of it. Then he says that the measurer is to *observe* whether the ship is "full or very full, hollow or very hollow," and that *he* is to add or subtract accordingly 5 or 10 per cent. as the case may be. He proposes a similar process for each of the other parts, and these being added together and divided by 40, will give, he says, the roomage or measurement at 40 feet to the ton. Now would these operations not take quite as long as the existing mode, which Mr. Atherton does not deny gives the correct cube contents; and would they be correct? I am sure he must have great doubts of their accuracy, for he knows not, any more than I do, the position of the two lines on which he bases them. But what about the trimming of the model according to the measurer's professional eye, who, likely enough, may be some insolvent butcher, or baker, or broken down village politician, appointed through our precious system of Parliamentary patronage to a berth in the Customs? What kind of regulation would *he* make of the 5 or 10 per cent., more or less, which is proposed to be left entirely in his hands?

Truly Mr. Atherton does advocate a very pretty way indeed of ascertaining the correct tonnage of a great maritime nation, such as England. After all his parade of science, he gravely proposes the most arrogant piece of quackery it has ever been my lot to read. In the very centre of civilization, and in a Journal read by the truly scientific men of every country—and by quacks too, I fear—Mr. Atherton, a Chief Engineer in one of our Royal Dockyards, "nails his colours to the mast," and asks the shipowners of England to adopt and legalise a scheme which has absurdity on the face of it—an absurdity which must be apparent to the most illiterate of the class whom he appears so heartily to despise.

It is indeed a pity that the government cannot keep him better employed than agitating against a plan which they themselves, after mature consideration, have adopted, and which, so far as it has been allowed to progress, has given every satisfaction to the interests who are the best judges of its merits, or for whose benefits it has been established. He must excuse me when I say that, after a careful perusal of his Paper on Tonnage Registration, I must inquire and see what he knows about engineering, for if he propounds similar plans in his own particular department, and is allowed to act upon them, the public purse, of which I am a very humble guardian, may suffer somewhat considerably.

I am, Sir, your obedient servant,

W. S. LINDSAY.

8, Austinfriars.

DECIMAL SYSTEM OF MONEY.

Sir,—I desire to bring this subject before the notice of the Society, from a point of view under which, as I think, it has not been sufficiently considered.

The extent of labour which might be saved by the use of logarithms and other tables, and by the slide rule, if our whole metrical system were decimalised, is obvious; but it is not generally perceived how much would be gained in this way, were our money alone to be decimal. Indeed, it is one of the most frequent arguments against the change proposed in our accounts, that it is useless to adopt a decimal system by halves; and, therefore, why change our money, and leave our weights and measures as they are? This argument can be satisfactorily answered only by a consideration of the actual mode in which tables affect commercial arithmetic.

We have at present, and can have, no universal "Ready Reckoner." With our present system, each tradesman must have separate books for his wholesale and retail business, and each trade requires a different set. These books are sufficiently cumbrous, and still often require several references and additions to get the required result. This, in a great measure, defeats the purpose of the "Ready Reckoner," and it would be almost entirely obviated if the money alone were decimal.

The great difficulty of adapting any sort of tables to our present monetary notation, arises from the fact that, in general, no two multiples of a sum expressed in £ s. d. have the same digits. Thus, neither 10, 12, nor 20 times £2 18s. 5d. are £218 5s., or £21 8s. 5d.; and, if 4 times either of these amounts be given, it does not enable us to see at a glance what 40 times the original amount is. Now, if our money be decimal, to know the value of 4lbs. of beef, is also to know the value of 40lbs., of 400lbs., or of 4,000lbs. Moreover, the price of 27 articles at 3d., does not tell us the price of 27 articles at 3s., or at £3. With decimal money, one entry in our table tells us all these, and the prices of 270, of 2,700, and of 27,000 also. This leads us to such a consolidation of our tabular arithmetic, as would render it available for miscellaneous use—a thing hitherto quite out of the question.

For the decimal accounts, the "Ready Reckoner" would contain a multiplication table up to 100 × 100, judiciously arranged, with auxiliary tables for the subdivisions required. There are very few purposes which would not be served by two auxiliary tables, one of 16ths (or oz. for lbs.), with ¼oz., ½oz., and ¾oz., and one of 12ths. There might also be a page or two for days in the week, month, and year, and a few similar things, and the "Reckoner" would not then exceed a pamphlet of two sheets 8vo, while it would be far more powerful than most that exist under the present system. One reference would serve common purposes—two references and an addition would serve most. Thus, to find 8,254 at £0·076, we should find, at one opening ·076 × 8200 = 623·2, and ·076 × 54 = 4·104, whence the answer £627·304. To find 97lbs. 6oz. of tea at £0·28 (= 5s. 7¼d. nearly), one opening gives 97 × ·28 = 27·16, and in another we find 6oz. at 0·28 per lb. to be ·105—giving £27·265 at the price required.

For counting-house purposes, a larger book might contain the multiplication table up to 100 × 1,000. This would make a volume of about 250 pages.

The use of LOGARITHMS in most branches of wholesale trade, has been prevented entirely by the want of a decimal system of money. The irregular sub-division of weights and measures would not have kept them out, any more than the sexagesimal division of the circle has kept them out of trigonometry. The main object of all commercial calculation is, to obtain money values, and each trade can well afford to keep and use a table of decimal equivalents for the sub-divisions of its metrical unit. But the money reductions occur so frequently, that it is only complicated work, like that which concerns interest or annuities, in which it is worth while to use decimals under the existing system of accounts.

Mathematical history affords an example of the partial introduction of a decimal system with success, while the attempts at its complete adoption signally failed. In the earlier days of trigonometry, the radius, as well as the arc, was divided sexagesimally. This division dated from the time of Ptolemy, if not of some previous astronomer, and continued long after the introduction of decimal notation in arithmetic. The first step made was to publish a table of sines to the radius 6,000,000; Purbach and Regiomontanus, in 1541, published double tables of sines to the radii of 6,000,000 and 10,000,000. In 1581, Maurice Bressius published tables, in which, not only is the radius made equal to 60°, but the sines themselves are sexagesimally expressed. The decimal division of the radius had, however, been already established by Rheticus, Vieta, and Pitiscus.

The next step was taken by Henry Briggs, the inventor of the common logarithms. He was afraid to venture upon the complete decimal division of the quadrant, but he used the centesimal division of the degree, in the same way as we still subdivide seconds. I do not find that he was followed by any one except John Newton (A.D. 1654, and 1658). From that time until the French Revolution, we find nothing but the decimal division of the radius and the sexagesimal division of the degree.

The French Directory decided that the division of the arc should be made to correspond with the rest of their metrical system. In 1799 and in 1801, very good tables were published in Berlin and Paris for this system, and the finest set of tables ever collected, the Grandes Tables du Cadastre, were computed under the care of Prony. But the thing never took, out of France, and even there it did not flourish. The last set of tables that I can hear of with the decimal division of the quadrant, is Didot's stereotyped table of 1814, to six figures; and in this, there is a table of logarithmic sines and tangents for degrees and sexagesimal minutes. The Tables du Cadastre were never printed, and still remain in MS. in the library of the Paris Observatory.

The mathematician has far more complex calculations than any merchant or banker, and is quite as well aware as any one can be of the advantage of economy in computation. He soon discovered, and held fast to, the advantage of the decimal division of the radius, his great medium of comparison, occupying the same place in his system of accounts, as the £ s. d. entries in the trader's books. He did not consider the advantage of extending his decimal division beyond his medium of reference, equal to the trouble of the change. The failure of the French experiment showed that he was right.

The foregoing considerations and example enable us, as I think, altogether to avoid the offered dilemma of decimalising our whole metrical system, or leaving our standard of value untouched. The former alternative is impossible. The year cannot be decimally divided into days; and even the French Directory did not suggest ten months for a year, or a similar division for the day.

I have the honour to be, Sir,
Your obedient servant,
CHARLES W. MERRIFIELD.

13, Brompton-row, Jan. 28, 1856.

Proceedings of Institutions.

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ALTON.—The Museum of the Mechanics' Institution, which was recently opened, contains upwards of 4,000 specimens, including: Zoology—Quadrupeds and Birds, chiefly British, 110; Eggs of British Birds, 430; Shells, 360; British Land and Freshwater Shells, 300; Comparative Anatomy, chiefly Osteology, 250. Botany—A few Specimens. Geology—Local, 900; British, 1,200. Mineralogy—260. Coins, and Local Antiquities—300. Miscellaneous—100. It is open to the members, free, with the privilege of purchasing a Yearly Family Ticket for 2*s.* 6*d.*, if Annual Subscribers, or 1*s.* 6*d.* if Quarterly Subscribers. Non-member's Yearly Tickets are 2*s.* 6*d.* each for an individual, and 5*s.* for a family. Single admissions 6*d.* The Working Classes are admitted on Saturday evenings for 2*d.* each. The Committee, being desirous of giving the Museum, as much as possible, an Educational character, have formed a Natural History Class, which meets every Friday evening in the Museum. It is proposed that short but systematic Conversational Lectures should be given, illustrated, as far as possible, by the specimens in the Museum; and that the Members of the Class take every opportunity of bringing specimens to the meetings, and of adding to the contents of the Museum, more especially in the department of Local Natural History. Classes from public schools in the town and neighbouring villages are to be admitted gratuitously. It appears that there is still remaining against the Institution a balance of 45*l.* 4*s.* 6*d.*, on account of the purchase and fitting up of the premises.

CAMBERWELL.—On Tuesday, the 5th inst., Mr. C. Charles gave, for the first time, a most amusing lecture to the Literary and Scientific Institution, on "The Ludicrous and Lyrical Literature of Love." The subject was well handled by Mr. Charles, who gave several illustrations, from different authors, of Love in its different phases, both cheerful and lugubrious. The memorable Valentine from Sam Weller to Mary, and the scene from the "Merry Wives of Windsor," describing the ducking of Sir John Falstaff, were received with great favour. Mr. Charles's sketch of an excited Frenchman and a wideawake Yankee, was most amusing, and showed that he possessed great versatility of talent. The Lecture was enlivened with several songs, such as the "Standard Bearer," "Widow Machree," "Love Not," and many others, and gave great satisfaction to a large audience.

Crieff.—The winter session of the Mechanics' Institution commenced in November last, and was opened by a very interesting address from the President, Mr. Laurie. On the 14th January, Mr. Sheriff Barclay, LL.D., delivered the first public lecture of the session; the subject was "Matter and Mind," and the learned gentleman discoursed most eloquently and impressively on the vast powers of the human mind, and its amazing and growing triumphs over the material universe, as proving its divine source, and pointing to its glorious destiny in the mysterious future of man's existence. On the 7th January, a musical *soirée* was held in the Freemasons' Hall, under the auspices of this Institution. In their preliminary arrangements, the committee were warmly aided by Sir William Keith Murray, Bart., of Ochtertyre; and through his kind offices they were enabled to enter into an arrangement with the celebrated violincello performer, M. Dreschler, of Edinburgh, and the astonishing young violin performer, Master Carl Rossi, from Germany, who is only twelve and a-half years of age. Sir William was kind enough to take charge of the entertainment, which his knowledge and taste so well qualified him to do. The programme consisted of a judicious selection of some of the finest pieces of music, intermingled with various Scottish melodies. The worthy Baronet condescended to take part in the concert, and his performances on the clarionet were such as few amateurs ever can hope to reach. The piano-forte accompaniments were chiefly executed by Mr. Davidson, of St. Paul's Chapel, Edinburgh, in the most efficient manner; he also performed a fantasia on the harmonium. After the exhibition of various comic illustrations of character and some beautiful chromatropes, by means of a powerful magic lantern, votes of thanks were passed by acclamation to Sir William K. Murray and all concerned in the entertainments of the evening. A very large and respectable audience assembled in the same place, on the evening of the 24th January, to hear William Stirling, Esq., of Keir, (M.P. for the county), deliver his promised lecture on "The Writers on the War." The honorable lecturer criticised a little severely the various explanations given of the objects we have in view in fighting the battles of Turkey against the Russian emperors, and thought that the only intelligible view of the matter was the defence of our Eastern possessions, and that France had a similar motive in the preservation of her noble colony of Algeria. He then gave a rapid and very lucid sketch of the rise and progress of the war, elucidating the subject by reading a number of thrilling details of the leading events of the campaign on the Euxine and Baltic, culled from the writings of many of the authors who have written on the war. The books containing these passages were most liberally presented by the lecturer to the library of the institution. On the motion of the Rev. J. R. Ormond, who very warmly eulogised the talents of the honourable member as an author and lecturer, a very hearty vote of thanks was given to him for his able and interesting lecture. Dr. Fairless (Hon. Secretary) then moved the thanks of the meeting to the Chairman, Thomas Graham Stirling, Esq., of Strowan.

London.—On Thursday evening, the 17th ult., Mr. Alfred Bunn gave his popular American entertainment, entitled "A Visit from John to Jonathan," to the members of the London and South Western Railway Literary and Scientific Institution. The chair was taken by Mr. F. J. Macaulay, the Honorary Secretary. The Lecturer briefly described the famous cities of Boston, New York, and Washington, and ably narrated some amusing incidents attending his visit to those places, and touched generally upon the character, industry, habits, and feelings of their inhabitants. Among the most interesting of the many statistical details of the lecturer, were those connected with the great Falls of Niagara, which Mr. Bunn described and explained in a manner which drew forth repeated plaudits from his numerous hearers. The lecture occupied two and a-half hours in delivery, and excited the greatest interest of a crowded audience.

Radway (near Banbury).—The half-yearly meeting of this Institution was held on Wednesday, the 23rd ult. The chair was occupied by Mr. J. Hoare. The meeting was attended by about forty of the members. This Society, which has now been established three years, has improved much during the past six months. Classes have been formed for teaching writing and arithmetic twice a week during the winter, and have been attended by seventeen pupils. During the last five months, the number of books and periodicals taken out of the library have been, by 55 males, 484; and by 11 females, 78; total, 562; being an average of 8·5 to each person. The number of members is 86. During the last quarter 1,231 persons have attended the reading-room, giving an average of 14 per night.

MEETINGS FOR THE ENSUING WEEK.

Mon. London Inst., 7, Dr. John Tyndall, "On the Nature and Phenomena of Heat."
Architects, 8.
Geographical, 8½, 1, "Remarks on the Open Sea in the North Polar Basin." 2. Mr. A. G. Gregory, "Progress of the North Australian Expedition." 3. Mr. James Wilson, "Letter to Sir Roderick J. Murchison on the same." 4. Mr. H. Landor, "Notes on the probable Condition of the Interior of Australia." 5. Report of Surveyor R. Austin, Commanding the Expedition to explore the Interior of Western Australia, N. and E. of the settled districts.
Tues. Royal Inst., 3, Prof. Huxley, "On Physiology and Comparative Anatomy."
Syro-Egyptian, 7½, Dr. Benisch, "On Rabbi Petachia's Travels in Palestine."
Civil Engineers, 8, Renewed Discussion upon Mr. Robinson's Paper, "On the Past and Present Condition of the River Thames."
Med. and Chirurg., 8½.
Zoological, 9.
Wed. Literary Fund, 3.
London Inst., 3, Mr. Robert Grant, "On Elementary Astronomy."
Society of Arts, 8, Mr. Henry Chance, "On the Manufacture of Crown and Sheet Glass."
Graphic, 8.
Ethnological, 8½.
Roy. Soc. Literature, 8½.
Thurs. Royal Institution, 3, Professor Tyndall, "On Light."
London Inst., 7, Mr. R. E. Grant, "On the Natural History of Extinct Animals."
Antiquaries, 8.
Royal, 8½.
Fri. Geological, 1, Anniversary.
Royal Institution, 8½, Prof. Huxley, "On Natural History as Knowledge, Discipline, and Power."
Sat. Asiatic, 2.
London Inst., 3, Mr. T. A. Malone, "On the Elementary Principles of Animal and Vegetable Chemistry."
Royal Institution, 3, Professor Odling, "On Organic Chemistry."
Medical, 8.

To Correspondents.

Erratum.—In the account of Major Pratt's patent, No. 3,309—1810, of last week, for "a series of ploughs revolve on a horizontal axis"—read, *a series of ploughs revolve horizontally on a vertical axis.*

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Delivered during the Vacation, 1855.

391. Poor Law Union Clerks—Return.
434. County Courts—Return.
502. Officers (Navy)—Returns.
515. Church Convocation (Nova Scotia)—Return.
427 (1). Sale of Beer, &c.—Index to Report, &c.
462. Fines and Penalties (Ireland)—Abstract of Accounts.
482. Income Tax—Return.
483. Poor Relief—Returns.

489. Select Committees—Return.
508. Chicory—Copy of Orders, &c.
509. Chemical Establishment (Excise Department)—Return.
402. Standing Orders.
432. Adulteration of Food, &c.—1st Report.
365. Metropolitan Workhouses, &c.—Returns.
397. County Courts—Return.
477. Metropolis Turnpike Roads—Returns.
484. Private Bills—Return.
506. Spirits (Scotland)—Return.
521. Kensington Gardens, &c.—Return.
525. Convocation—Address.
465. Dividends (Public Funds)—Correspondence.
466. Royal Society—Account.
474. Joint Stock Companies—Report.
487. Public Bills—Alphabetical List.
491. Petitions for Private Bills—Return.
512. Balaklava Harbour—Correspondence.
514. East India (Assistant Surgeons)—Report.
528. Income Tax, &c.—Return.
532. New Churches—35th Report.
65 (7). Trade and Navigation Accounts (31st July).
398. County Treasurers—Abstract of Accounts.
436. Westminster New Palace (Great Clock and Bells)—Papers, &c.
448. Navy, Army, &c. (1853-54)—Detailed Accounts of Receipts and Expenditure.
460. Railways—Return.
468. National Gallery—Minutes of the Trustees.
469. Duchy of Lancaster—Account.
471. Demerara—Correspondence.
472. Statute Law Commission—Replies from Messrs. Anstey and Coode.
473. Steam Vessels—Return.
488. Sittings of the House—Return.
492. Divisions of the House—Return.
495. Civil Bills, &c. (Ireland)—Returns.
499. County Courts (Ireland)—Return.
501. Agricultural Statistics—Lords' Report.
517. Transports—Return.
519. Militia—Return of Regiments Embodied.
523. Bristol Port—Report of the Colonial Land and Emigration Commissioners.
520. Militia—Return of the Strength of each Regiment.
526. Conseils de Prud'hommes (France and Belgium)—Memorandum.
423. East India (Selections from Records of Government)—Return.
445. Postal Arrangements (Waterford, &c.)—Report.
500. Corporate Accounts (Ireland)—Return.
524. Population, &c.—Returns.
534. High Constables—Return.
479. Burial Fees—Returns.
420. Torture (Madras)—Return.
447. Printing (Houses of Parliament, &c.)—Report.
504. Sugar, &c.—Return.
513. East India (Civil Service)—Copy of the Reports.
518. Naval Prizes—Return.
65 (8). Trade and Navigation Accounts (31st August).
530. Public Offices and Civil Service—Papers, and Index to Reports.
366. Finance Accounts—Classes 1 to 8.
421. Stoppage of Wages (Hosiery)—Report from Committee.
496. National Debt—Return.
415. Metropolitan Communications—Report.
470. West India Islands Relief—Correspondence.
480. Adulteration of Food, &c.—Second Report.
358. Woods, Forests, &c.—33d Report of Commissioners.
476. Kingstown Harbour—Copy of Instructions to Mr. Rendel.
478. Tower Hill, &c. Paving—Correspondence.
510. Railways—Returns.
530 (1). Civil Service—Index to Reports, and Papers relating thereto.
481. Public Prosecutors—Report from Committee.
65 (9). Trade and Navigation Accounts (30th September).
415 (1). Metropolitan Communications—Index to Report.
475. Grand Jury Presentments (Ireland)—Abstract of Accounts.
529. Divisions of the House of Commons, 1836-1852—General Index.
490. Business of the House—Return.
494. Income Tax—Return.
507. Tea, &c.—Return.
65 (10). Trade and Navigation Accounts (31st October).
480 (1). Adulteration of Food, &c.—Index to Reports.
443. Municipal Boroughs (England and Wales)—Abstract of Return.
498. Election Auditors—Abstract of Return.
65 (11). Trade and Navigation Accounts (30th November).
485. Private Bills—Returns.
486. Public Petitions—Returns.
533. Fees (Clerks of Assize, &c.)—Abstract of Return.
527. Public Appointments—Return.
531. Public Petitions (1833-1852)—General Index to Reports.
493. Savings Banks—Return.
497. Savings Banks—Return.
453. Public Income and Expenditure—Account.
486 (1). Public Petitions—Abstract of Sums paid for Printing, &c.
505. National Gallery, &c.—Returns.
497. Savings Banks—Returns (a corrected leaf).
318. Army before Sebastopol—Index to Reports.
247. Bills—Colonial Appeals.
267. Bills—Insolvency and Bankruptcy (Scotland) (amended).
203. Bills—Bankruptcy and Insolvency (Ireland).
Public General Acts—Cap. 82 to 134, and Table.
Lunatic Asylums (Ireland)—7th Report.
War with Russia—Further Papers.
South Staffordshire Railway (Collision at Dudley Station)—Further Correspondence.
Trade and Navigation (1841 to 1850)—Tables.
Statistical Tables (Foreign Countries)—Part 2.
Inclosure Commission—Special Report.
Convict Prisons (Pentonville, &c.)—Reports of Directors.
General Board of Health—Report of the Medical Council.
General Board of Health—Report on the Results of the different Methods of Treatment of Cholera (1854).
Military Prisons (1854)—Report by Colonel Jebb.
Australian Colonies (Convict Discipline and Transportation)—Further Correspondence.
Railway Accidents (June)—Reports.
Mining Districts—Report of the Commissioner.
River Tyne—Analytical Index.
Coal Mines—Report of Inspectors (Messrs. Dunn, Dickenson, &c.).
Coasting Trade (Foreign Countries)—Despatches.
Sierra Leone (Prevention of Slave Dealing)—Papers.
Trade of Foreign Countries—Abstract of Reports.
General Board of Health (Cholera Epidemic of 1854)—Appendix to Report.
General Board of Health (Cholera Epidemic of 1854)—Two Diagrams.
Sierra Leone (Moriah Chiefs)—Correspondence.
National Education (Ireland)—21st Report, vol. 1, part 2.
Inns of Court and Inns of Chancery—Report of Commissioners.
Trade and Navigation of the United Kingdom (1854)—Annual Statement.
Railways—Return respecting the number of Passengers, &c. (30th June, 1855).
Turnpike Trusts (England and Wales)—Abstract of General Statements of Income and Expenditure.
Prisons—20th Report of the Inspectors (Southern and Western District), part 3.

Delivered on 1*st February*, 1856.

Session 1854-5.

503. Colonial Expenditure—General Abstract.

Delivered on 2nd and 4th February, 1856.

Agricultural Statistics (Scotland)—Report.
Agricultural Statistics in Ireland (1854)—Returns.
British Army in the Crimea—Report of the Commission of Inquiry.
British Army in the Crimea—Appendix to the Report.
Disturbances in Hyde-park—Report of Commissioners.
Sweden and Norway—Treaty.
France (Printed Papers by Post)—Convention.
Prussia (International Copyright)—Convention.
Japan (Admission of British Ships)—Convention.
Turkey and Sardinia (Joint Captures)—Convention.
Divisions of Trophies and Booty—Declaration signed at Paris.
Chili—Treaty of Friendship, Commerce, and Navigation.

Delivered on 5th February, 1856.

1. Public Income and Expenditure (Balance Sheet)—Account.
4. Naval Receipt and Expenditure—Account.
1. Bills—Partnership Amendment.
2. Bills—Joint Stock Companies.
Poor Relief (Scotland)—10th Report of the Board of Supervision.
Queen's University in Ireland—Report.

Delivered on 6th February, 1856.

5. General Committee of Elections—Mr. Speaker's Warrant.
7. Bill—Metropolitan Police.

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette February* 1*st*, 1856.]

Dated 14*th November*, 1855.

2572. Alfred Vincent Newton, 66, Chancery-lane,—Improvements in the construction of locks. (A communication.)

Dated 2nd January, 1856.

8. Andrew Shanks, 6, Robert-street, Adelphi—Improvements in machinery for cutting screws.

Dated 12*th January*, 1856.

89. Alexander Bain, Westbourne-park-road, Paddington—Improvements in the construction of inkstands.
91. Charles François Leopold Oudry, 39, Rue de l'Echiquier, Paris—Improvements in the preservation of metals and other solid substances.
93. William Owen, Rotherham—Improvements in the manufacture of railway wheels and tyres.
95. Alexander Bankier Freeland, Manchester—Improvements in the preparation of flour for the purposes of its better preservation and carriage, and in the machinery or apparatus employed therein.

Dated 14*th January*, 1856.

97. William Collett Homersham, Caroline Villas, Kentish Town—Improvements in machinery for the preparation of hemp, flax, and other fibrous materials.
99. Adolf Pollak, Vienna—Treating waste oily matters to obtain a product applicable to the manufacture of soap and other useful purposes in the arts.
101. Nathaniel Shattswell Dodge, 44, Saint Paul's Churchyard—Improvements in the preparation or manufacture of leather cloth.
103. John Gottlieb Ulrich, 63, Mark-lane—Improvements in chronometers and other time-keepers

105. Abraham Gerard Brade, Paris—Improvements in recovering the wool from fabrics in which the same exists, together with silk or vegetable textile fibres.

Dated 15th January, 1856.

107. Pierre Theophile Auguste Nicoulland, 39, Rue de l'Echiquier, Paris—Improvements in steam boiler furnaces. (A communication.)
109. Samuel Sheppard, Birmingham—Improved tap or stop-cock.

Dated 16th January, 1856.

113. Henry Law, 15, Essex-street, Strand—Improvements in heaving-up slips for the repair or construction of ships or other vessels, and for a continuous-action purchase for the same which is also applicable to other purposes.
115. Vincent Scully, and Bennett Johns Heywood, Dublin—Improvements in the construction of inkstands, applicable in part to other vessels for the reception of fluids.
117. John Hamilton, junior, Liverpool—Improvements in the posts or uprights employed in constructing electric telegraphs.
119. John Hamilton, junior, Liverpool—Improvements in constructing the permanent ways of railways.
121. David Dring, 149, Great Dover-road—Improvements in machinery for cutting wood pegs. (A communication.)

Dated 17th January, 1856.

123. Peter Armand le Comte de Fontainemoreau, 4, South-street, Finsbury—Improved apparatus for the prevention of accidents or collisions on railways. (A communication.)
124. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improved gas-meter. (A communication.)
125. Philipp Rechten, Bremen—The taking of whales and other cetaceous fish by means of a harpoon constructed on entire new principles.
127. James Jackson, Manchester—Improved apparatus for retaining and releasing cords of "Venetian blinds," or cords, bands, or chains employed for other purposes.
128. Oliver Philcox, 30, Willes-road, Kentish Town—Increasing the effect and the facility in fingering the pianoforte, organ, or other musical instrument having a keyboard.
129. William Chapman, Sunderland—Improvement in propelling vessels.
130. Joseph Jesse Comstock, New York—Improvements in generating steam. (A communication.)

Dated 18th January, 1856.

134. Joseph Moseley, Well Walk, Hampstead—The transport of all goods, merchandise, and valuable commodities whatsoever.
136. Joseph Schloss, Wellington Chambers, Cannon-street West—A piston bolt, or certain improvements in fastening travelling bags, portmonnaies, cigar cases, writing desks, drawers, doors, and similar objects where locks, bolts, or clasps are employed.
138. Henry Griffith Rule, Manchester—Improvements in machinery or apparatus for measuring water or other fluids.
140. Edward Myers, Rotherham—Improvements in buffers and other springs for railway and other carriages.
142. François Jules Manceaux, Paris—Improvements in fire-arms.
144. Charles Weightman Harrison, Woolwich—Improvements in transmitting communications, and in the apparatus employed therein.
146. James Buckley, Oldham—Improvements in looms for weaving.

Dated 19th January, 1856.

148. Alfred Dawson, 14, Barnes place, Mile End Road—An apparatus for converting small coals, or coal dust, or small coals and coke, or coal dust and coke, with the admixture of water or other materials, into solid blocks of fuel, parts of which apparatus can be used and are suited for other purposes.
150. John Armour, Kirkton Bleach Works, Renfrew—Improvements in bleaching, washing, or cleansing textile fabrics and materials.
152. Thomas Horsfall, Deptford, and William Turnbull, Rotherhithe—Improved machinery for breaking and preparing hemp, flax, and other similar vegetable fibres.
154. Herman John Van den Hout, and Ebenezer Brown, Kentish Town—Improvements in the preparation of pulp for the manufacture of paper, millboard, and other like purposes.

Dated 21st January, 1856.

156. Rev. Samuel Fenton, Saint Mary's, Wavertree, Lancaster—Improvements in locks and fastenings.
158. John Gedge, 4, Wellington-street South, Strand—Improvements in the manufacture of boots or shoes. (A communication.)

Dated 22nd January, 1856.

162. Pierre Lewis Tieffé-Lacroix, Metz—Improvements in machinery for cutting files.
164. John Gedge, 4, Wellington-street South, Strand—Improvements in wrought iron wheels. (A communication.)
166. Peter Armand le Comte de Fontainemoreau, 4, South-street, Finsbury—Improvements in machinery or apparatus for manufacturing nails. (A communication.)
168. Thomas Hitt, Tavistock-street—Certain arrangements of machinery for converting reciprocating into rotary motion.
172. John Beech and Edward Jeffreys, Shrewsbury—Improvements in the means of supporting the rails of railways.

Dated 23rd January, 1856.

175. John Onions, Wellington-place, Blackfriars-road, Southwark—Improvements in the manufacture of iron.
176. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improved manufacture of yarn from wool or other felting material. (A communication.)
180. Johannis Joachim Mathias Meyer, Bartlett's Buildings—Improved mode of manufacturing bank notes, cheques, and other like documents.
182. Archibald Turner, Leicester—Improvements in the manufacture of elastic fabrics.
184. James Newman, Birmingham, and William Whittle, Smethwick—Improvements in the manufacture of shafting for mill and engine purposes, which improvements are also applicable to the manufacture of shafts, poles, beams, masts, spars, and other similar articles, in which great strength or lightness, or both these qualities combined, may be requisite.

WEEKLY LIST OF PATENTS SEALED.

Sealed February 1st, 1856.

1741. Samuel Mellor and Thomas Young.
1748. John Stanley.
1750. Samson Woller and Illingworth Butterfield.
1760. Frederick Robert Augustus Glover.
1790. William Mitchell Tilleston.
1795. John Coope Haddan.
1812. George Durham and Cornelius Wyatt.
1818. Philip Latour and Maurice Latour.
1819. Pontus Lagergren.
1845. John Coope Haddan.
1851. John Avery.
1853. John Barber.
1855. Peter Armand le Comte de Fontaine Moreau.
1881. Alexander Bain.
1886. Pierre Gontier.
1888. Robert Longsdon.
1890. George Lewis.
1902. William Pitt and Edward Turner Davies.
1912. William Kidman.
1925. William Brown.
1943. Charles Esplin.
2010. Agostino Palmiéri and Jean Baptiste Ferrari.
2019. James Fraser.
2027. John McIntyre.
2111. James Willis.
2626. Peter Armand le Comte de Fontaine-Moreau.
2632. George Price.
2820. John Henry Johnson.

Sealed February 5th, 1856.

1778. Henry Gilbee.
1779. Fischer Alexander Wilson.
1780. John Platt and John Hibbert.
1786. James Alexander Manning.
1797. Philippe Amédée Devy.
1809. Alfred Heaven.
1885. Henry Knighton.
1921. C. Schlickeysen.
1969. John Hope and Thomas Hope.
2227. William Spence.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

January 28th.

230. John Ryall Corry and James Barrett Corry.
241. Jean Baptiste Lavanchy.
251. Louis Guillaume Perreaux.
337. John Perkins.

January 29th.

252. Edwin Pugh.
290. Thomas Spiller and Anthony Crowhurst.

January 30th.

256. David Chalmers.
258. Frederick Lawrence, William Davidson, and Alfred Lawrence.
273. John Cockerill and Thomas Barnett.
310. Jacob Vale Asbury.

Feburary 1st.

299. Alfred Taylor and Henry George Frasi.
302. William Brown.

February 2nd.

283. Auguste Edouard Loradoux Bellford.
292. John Heckethorn.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
3807	February 1.	Clasp for Belts and other Articles of Dress	Smith, Kemp, and Wright	Birmingham.
3808	February 2.	Lamp for Omnibuses and other Carriages	Price's Patent Candle Company	Belmont, Vauxhall.